INSTRUCTION MANUAL

MODEL 1403/1503
SWEEP GENERATOR

WAVETEK® INDIANA INC.

66 N. 1ST AVENUE, P.O. BOX 190

BEECH GROVE, INDIANA 46107

317—783-3221

Serial No._____

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WARRANTY

All Wavetek instruments are warranteed against defects in material and workmanship for a period of one year after date of manufacture. Wavetek agrees to repair or replace any assembly or component (except batteries) found to be defective, under normal use during this period. Transfermatic Switch assemblies, manufactured by Wavetek, are unconditionally warranteed for the life of the instrument. Wavetek's obligation under this warranty is limited solely to repairing any such instrument which in Wavetek's sole opinion proves to be defective within the scope of the warranty when returned to the factory or to an authorized service center. Transportation to the factory or service center is to be prepaid by purchaser. Shipment should not be made without prior authorization by Wavetek.

This warranty does not apply to any products repaired or altered by persons not authorized by Wavetek, or not in accordance with instructions furnished by Wavetek. If the instrument is defective as a result of misuse, improper repair, or abnormal conditions or operations, repairs will be billed at cost.

Wavetek assumes no responsibility for its product being used in a hazardous or dangerous manner either alone or in conjunction with other equipment. High voltage used in some instruments may be dangerous if misused. Special disclaimers apply to these instruments. Wavetek assumes no liability for secondary charges or consequential damages and, in any event, Wavetek's liability for breach of warranty under any contract or otherwise, shall not exceed the purchase price of the specific instrument shipped and against which a claim is made.

Any recommendations made by Wavetek for use of its products are based upon tests believed to be reliable, but Wavetek makes no warranty of the results to be obtained. This warranty is in lieu of all other warranties, expressed or implied, and no representative or person is authorized to represent or assume for Wavetek any liability in connection with the sale of our products other than set forth herein.

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SCHEMATICS AND PARTS LIST

CHANGE INFORMATION, IF ANY, IS LOCATED AT THE REAR OF THIS MANUAL.

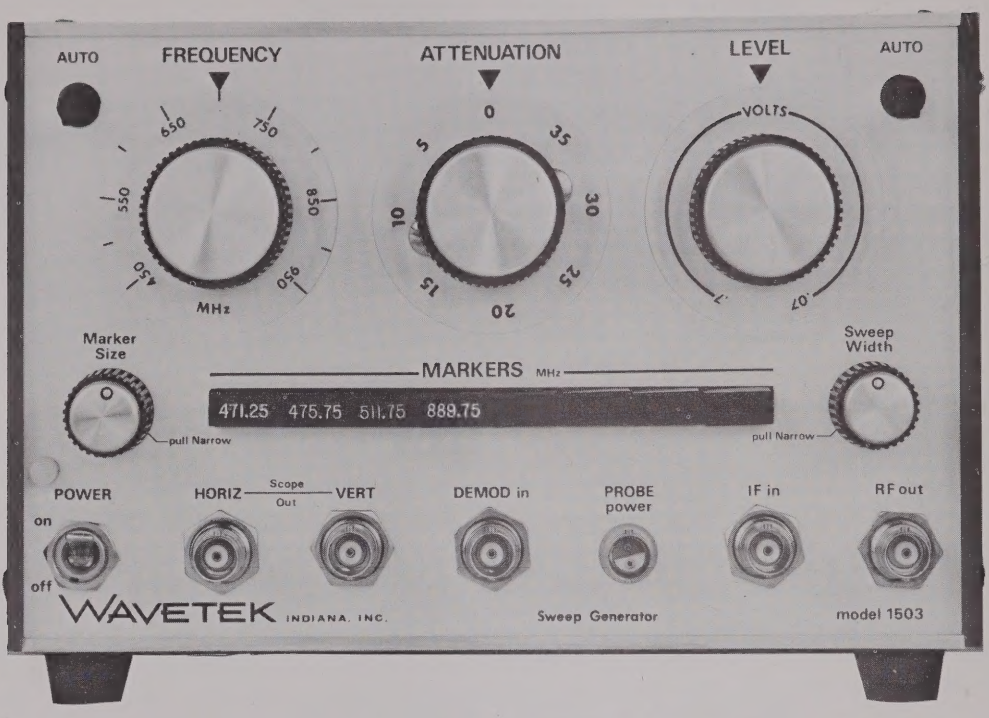


FIGURE i MODEL 1503 SWEEP GENERATOR

SCOPE OF THIS MANUAL

This manual provides descriptive material and instructions for the installation, operation, maintenance, and repair of the WAVETEK Model 1503 UHF Sweep Generator, and Model 1403 VHF Sweep Generator.

SECTION 1
GENERAL INFORMATION

1.1 INTRODUCTION

The Model 1503 is an all-solid-state, electronically swept and tuned UHF Sweep Generator covering the 450 MHz to 950 MHz frequency range. It is designed especially for testing and aligning UHF television tuners and receivers. The Model 1403 is the VHF counterpart and covers the frequency range of 1 to 300 MHz.

An important feature of these instruments is their ability to be remotely controlled and programmed. This enables the sweep generator to be sequenced to the test procedure with pushbutton switches or electronic sequencers instead of manual tuning and adjustments.

The unit's most outstanding option is that of automatic operation. Simply stated, in automatic operation the sweep generator frequency and RF output level is automatically adjusted to follow the variations of the tuner. This provides considerable time saving during the alignment procedure.

Included with the automatic options are scope indicators that provide both frequency and RF output indications directly on the oscilloscope tube. Additional options are eight crystal-controlled RF markers (either single frequency or harmonic type), and local oscillator tracking markers.

By the use of a special combining cable, the 1403 and 1503 may be operated as a combination unit providing independent frequency and output amplitude controls with a single set of scope horizontal and vertical cables. When operated as an automatic instrument, one set of tracking markers (option B, automatic level (option C), and automatic frequency (option E) provide control of both instruments.

All optional features, as well as the circuits for the basic sweep generator, have plug-in modular construction. This allows optional features to be factory installed at the time of purchase, or customer installed at a later date. This concept offers protection against obsolescence since updated and additional features can be simply and economically added as new tuner designs and test procedures dictate.

Maintenance problems can be greatly simlified by the stocking of several modules instead of hundreds of parts. Servicing time of a defective instrument can be cut to a fraction of the time previously required and can be performed by relatively inexperienced technicians.

The small, compact instrument is 5-¼" X 8" X 13" and weighs approximately 20 pounds.

1.2 SPECIFICATIONS

CENTER FREQUENCY RANGE	1403	1 to 300 MHz
	1503	450 to 950 MHz
SWEEP WIDTH	Adjustable from less than 5 MHz to the entire center frequency range.	
DISPLAY LINEARITY	2%	
RF OUTPUT (MAX)	.7Vrms	
RF OUTPUT IMPEDANCE	1403	standard 75 Ω (50 Ω optional)
	1503	standard 50 Ω (75 Ω optional)
RF OUTPUT FLATNESS	±.25 dB (measured with Wavetek D171 or D151 detector)	
ATTENUATION		
Step	0 to 35 dB steps (See option "D")	
Vernier	0 to 20 dB	
SWEEP RATE	AC line frequency 50/60 Hz	
BLANKING	RF output off during sweep retrace to provide a zero level base line.	
SCOPE HORIZONTAL	16V peak to peak triangular waveform	
RF MARKERS	Birdy by-pass marker system with provisions for 8 plug-in marker modules plus a rear panel external marker input. Markers may be either single frequency or harmonic (comb) type. (See options A1 and A2.)	
Marker Switches	Individual ON/OFF switches are provided	
Marker Size	Adjustable from approximately 3V to 3mV peak to peak.	
Accuracy	0.005%	
External Marker	Rear panel BNC connector accepts an external CW signal for conversion to a birdy marker. Input level: 100mV into 50 Ω.	

1.2 SPECIFICATIONS (Cont'd.)

OPTIONS	In addition to the RF marker option A1 and A2, the instrument is wired to accept several additional options. These may be factory or field installed. See paragraph 1.3 for complete details.
PROGRAMMING	Rear panel REMOTE jack provides necessary connections for remote control of frequency, sweep width and the 0-20dB vernier attenuator. It also provides the necessary connections to provide combined 1403/1503 operation.
POWER REQUIREMENTS Line Supply	115 or 230 VAC, ±10%, 50 to 60 Hz, approximately 20 watts.

MECHANICAL SPECIFICATIONS (See Figure 1-1.)

A For total length, including knobs, add 11/16

B For total height, including feet, add 5/8

C For total width, including screw heads, add 3/16 inch

Weight
Net - 20 lbs.
Shipping - 25 lbs.

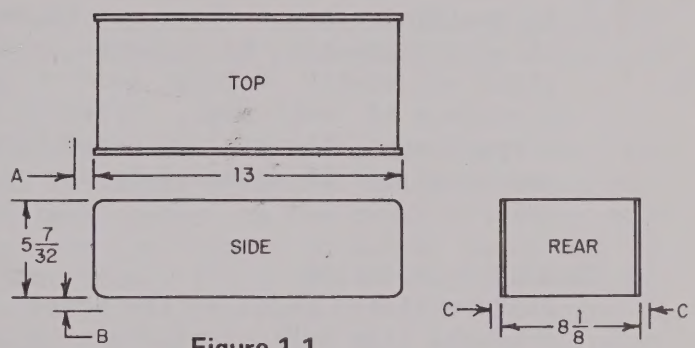


Figure 1-1.

1.3 OPTIONS

A1 Single frequency markers at any frequency within the instruments frequency range. (Module M6S-)

A2 Harmonic or comb type markers - 1, 10, 30, 50, 59 or 60 MHz intervals, other frequencies available on special order. (Module M6H-)

B IF Conversion L.O. Tracking Markers
This feature produces two or three pulse markers based on the IF output frequency from the tuner. They are used to indicate the RF bandwidth, local oscillator frequency and tracking. (Module M7E)

IF Input Frequency	28 to 47 MHz
IF Input Level	1 mV or more from a low impedance source. When measured in the test circuit shown in Figure 3-5 (a high impedance source), it requires a detected signal of over 5 mV.
IF Input Level with RB Probe	.01 mV from a low impedance source, or when measured as described above, a detected signal of over 50 uV.

1.3 OPTIONS (Cont'd)

Marker Frequency	Any two frequencies in the frequency range separated by less than 12 MHz; a third marker midway between the bandpass markers is used to control the Automatic Frequency, "E" option, and is not normally brought out as a marker pulse.
Marker Accuracy	.01%
Marker Output	Plus or minus 35 volt pulses available at a Rear Panel Connector. Markers may also be added to the Scope Vertical input as differentiated pulses.

C Automatic RF Level Control and Scope Indicators

This feature provides automatic adjustment of the 0-20 dB vernier attenuator to correct for variations in the gain of the tuner under test, and visual indications of the sweep generator center frequency and RF output level on the oscilloscope retrace. (Module M8E)

AUTOMATIC RF LEVEL

An amplitude change above or below the 1 volt reference level is automatically corrected by a change in the 0-20 dB RF level. The feature provides adjustable voltage gain of 100 and polarity inverting circuits to provide a +1 volt peak, detected tuner response pattern on the oscilloscope trace. The minimum demodulated input signal is .01 volt. The minimum level may be extended by use of the R6 probe. (See Accessories Available)

FREQUENCY INDICATOR

Differentiated pulse on the Scope retrace base line with the position on the base line indicating sweep center frequency. It will traverse the base line from left to right as the center frequency ranges from low to high.

RF LEVEL INDICATOR

Pedestal at the start of the scope retrace, the amplitude indicating vernier RF level. A pedestal 1 volt high indicates maximum RF output. The pedestal amplitude will vary in direct linear relation to the RF voltage.

D 70 dB Attenuation (10 dB steps)

This feature replaces the standard attenuator, 0 to -35 dB (5 dB steps), with one with twice the attenuation range. It is used when the tuner input signal attenuation requirements are beyond the range of the 35 dB step attenuator. NOTE: Since the attenuator increment is double, (5 dB to 10), the automatic adjustment range of the "C" option may be somewhat reduced when using the "D" option attenuator. (Attenuator 5070 or 7570)

E Automatic Frequency

This feature provides automatic frequency tracking of the sweep generator to the tuner under test, maintaining the demodulated response at the center of the scope display. The input requirement is provided by the "B" option and it will track any tuner, within the frequency range of the sweep generator, that will meet the IF input requirements of the "B" option. (Module M11E)

1.4 ACCESSORIES

1.4.1 Accessories furnished: Instruction manual and spare plug and pins to mate with the rear panel REMOTE jack.

1.4.2 Accessories available:

Wide Band IF Detectors	Model D151 for 50 Ω impedances (1503) and Model D171 for 75 Ω impedances (1403).
Service Kits	Kit K102 contains a module extender and necessary extension cable.
19 Inch Rack Mounting Kits	Kit K103 contains necessary hardware for rack mounting a single instrument in a 5¼ inch space. (See Figure 2-1.) Kit K104 contains necessary hardware for rack mounting two instruments in a 7 inch space. (See Figure 2-2.)
External Probes Model RB	Provides additional IF amplification for the "B" option. This extends it's minimum input from 1 mV to .01 mV.
Model R6	Contains a flat wide band amplifier, detector, and "B" option IF sample resistor. It is used to provide additional gains to the tuner IF output signal to improve the signal to noise ratio and to provide operation of the C option when the unamplified detected signal is below 10 mV. The model RB probe should not be required when the R6 is used.
Additional Marker Cabinet K105	This cabinet mounts to the top cover of the model 1403 or 1503 and provides space for five additional A1 or A2 options. Unit obtains power by plugging into one of the A1/A2 option sockets which reduces the maximum number of A1/A2 options installed in the unit to seven.
Combining Harness K106	This harness provides the necessary interconnection between the 1403 and 1503 to provide combination operation. (See Paragraph 3.9 in Operating Instructions, Section 3, for details.)

SECTION 2
INSTALLATION

2.1 MECHANICAL INSTALLATION

2.1.1 Initial Inspection

After unpacking the instrument, visually inspect the external parts for damage to knobs, connectors, surface areas, etc. The shipping container and packing material should be saved in case it is necessary to reship the unit.

2.1.2 Damage Claims

If the instrument is received mechanically damaged in transit, notify the carrier and either the nearest Wavetek area representative or the factory in Indiana. Retain the shipping carton and packing material for the carrier's inspection.

The local representative, or the factory, will immediately arrange for either the replacement or repair of your instrument, without waiting for damage claim settlements.

2.1.3 Rack Mounting

The instrument is 1/2 rack size and two rack mounting kits are available. The K-103 kit provides the necessary hardware to mount the unit to either the right or left of a standard 5¼" x 19" opening. The K-104 kit provides the necessary hardware to rack mount two instruments. These may be two 1000 or 2000 series Wavetek, Indiana Instruments, or two 130 or 140 series Wavetek, San Diego Instruments, or a combination of either. This provides a 7" x 19" package. Facilities are provided for Front Panel mounting of instrument Rear Panel connectors.

2.1.4 K-103, Rack Mounting Kit (Refer to Figure 2-1)

CONTENTS

Item	Qty.	Part No.
A (Side)	1 ea.	B000-608
B (Side)	1 ea.	C000-691
C (Screw)	8 ea.	HS101-806

Procedure:

Remove the screws from one side panel at a time. Mount item A or B against the side panel of the instrument and secure with screws provided (item C). Repeat operation for other side. NOTE: Items A & B may be interchanged to position the unit to the side of the rack desired.

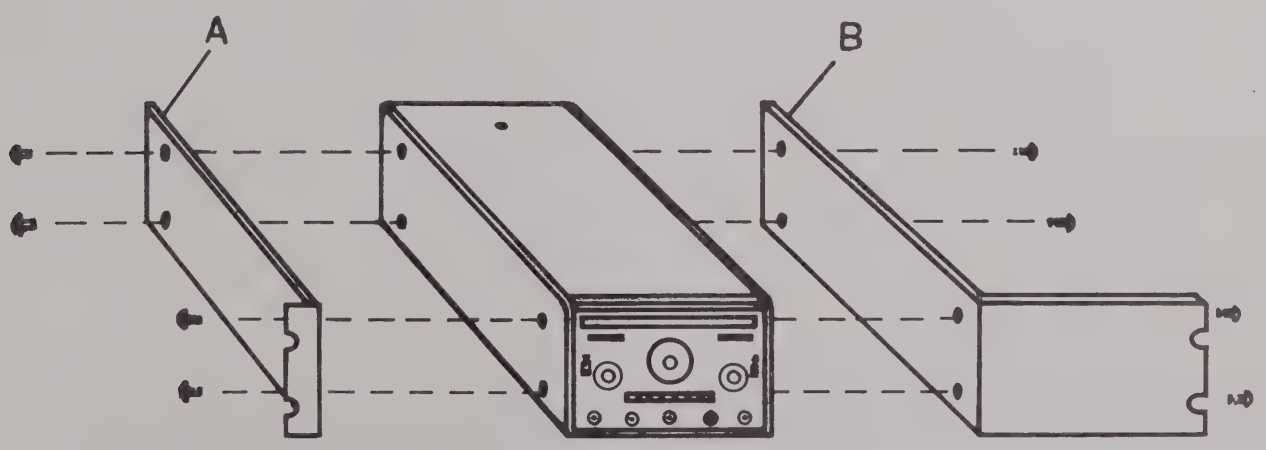


Figure 2-1. K-103 Rack Mounting

2.1.5 K-104 Rack Mounting Kit (Refer to Figure 2-2)

CONTENTS

Item	Qty.	Part No.
A (Tray)	2 ea.	C000-729
B (Side)	2 ea.	A500-230
C (Screw)	12 ea.	HS101-905

Procedure:

Install both sides (item B) to one tray (item A) using 10-32 x 3/16" screws (item C). Position the instrument on the tray so that the feet extend into the provided holes. Holes are provided for all Wavetek, Indiana 1000 and 2000 series and for most Wavetek, San Diego 130, 140, and 700 series instruments. Other instruments not exceeding 5¼" x 8" may also be mounted by drilling additional holes for their feet.

When one or both instruments are properly seated, install the other item "A" and secure with the remaining screws (item C).

NOTE: If the Wavetek instrument has been supplied with a bail, it must be removed before installing in the K-104 rack mounting kit.

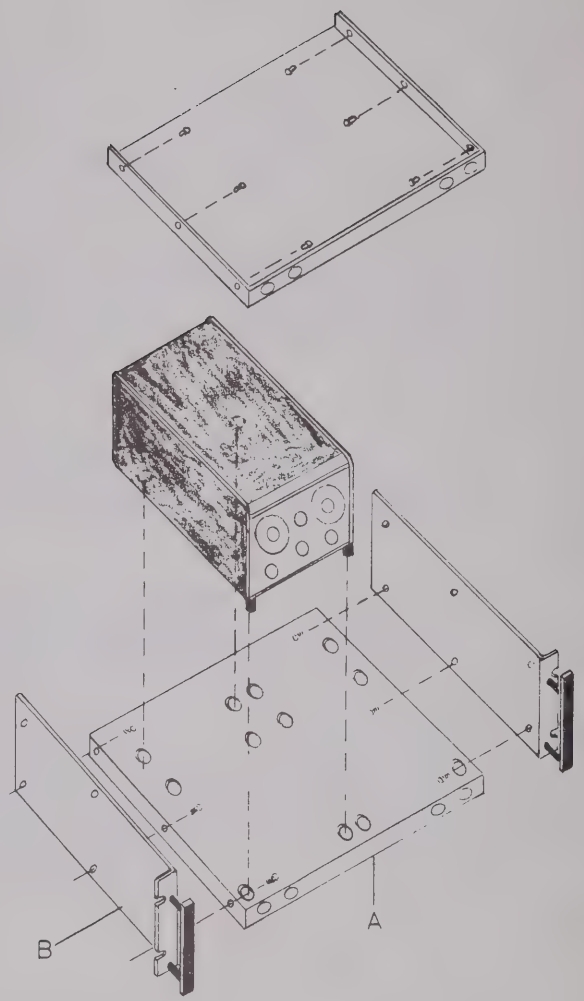


Figure 2-2. K-104 Rack Mounting

2.2 ELECTRICAL INSTALLATION

2.2.1 Primary Power Requirements

These instruments operate from either 115 volt AC or 230 volt AC supply mains as selected by a Slide Switch located on the Rear Panel. Before operating the instrument, check that the fuse mounted in the Rear Panel Fuse Holder corresponds to the correct value for the selected voltage; i.e., 0.5 amp for a 115 volt AC, and 0.25 amp for 230 volt AC.

The power supply has been designed to operate from either 50 or 60 Hz supply mains, however, the line operated sweep rate function must be adjusted to the line frequency.

Instruments are shipped from the factory for operation at 115 volt AC, 60 Hz unless specified for 230 volt AC or 50 Hz operation.

2.2.2 Performance Checks

The electrical performance of this instrument should be verified. Performance checks for incoming inspection are given in Section 5, Maintenance.

SECTION 3
OPERATING INSTRUCTIONS

3.1 INTRODUCTION

This section provides complete functional control description, operating instructions, and programming instructions for the Model 1403 and 1503 Sweep Generators.

Figure 3-1. Front Panel

3.2 DESCRIPTION OF FRONT PANEL

(1) FREQUENCY — A center frequency tuning control when the AUTO frequency switch is down (manual operation). When this switch is up (automatic operation) or when in remote operation, this control is not active.

(2) ATTENUATION — Provides calibrated adjustment of the RF output in 5 dB increments from 0 to 35 dB.

(3) LEVEL — Provides a 20 dB vernier adjustment of the RF output when the AUTO level switch is down (manual operation) when this switch is up (automatic operation), or when in remote operation, this control is not active.

(4)	MARKER SIZE pull NARROW	Control adjusts the marker amplitude. When the knob is pulled out, the birdy marker width is reduced.
(5)	MARKERS - (MHz)	Eight push button switches control A-1 and A-2 Marker Options (marker frequency is engraved on push button).
(6)	SWEEP WIDTH	Control adjusts the display sweep width from less than 5 MHz to the entire swept frequency range. When the knob is pulled out, the maximum sweep width is reduced to approximately 10% of the swept frequency range.
(7)	POWER ON	Toggle switch applies A.C. power to the power supply. The light indicates that the instrument is operating.
(8)	SCOPE HORIZ out	BNC connector provides a 16V peak-to-peak triangle waveform synchronized with the sweep oscillator, to drive the oscilloscope horizontal input.
(9)	SCOPE VERT out	BNC connector provides the DEMOD input signal combined with the marker signal (and also the scope frequency and level indicators when option C is installed) for connection to the scope vertical input.
(10)	DEMOD in -	BNC connector accepts the demodulated swept signal from the device under test, so that RF markers may be added, and also adds the scope frequency and level indicators when option C is provided. This signal is also used to control the automatic RF level circuits of option C.
(11)	PROBE POWER	BNC twinax connector supplies +18 and -18 volts to power an external probe if required for automatic operation of the instrument.
(12)	IF INPUT	BNC connector accepts an IF sample from the device under test to generate IF tracking markers when option B is installed. This signal is also used to control the automatic tuning circuit option E. *NOTE: Option B must be provided if the automatic tuning option is required.*
(13)	RF out -	BNC connector provides a connection for the RF output signal.

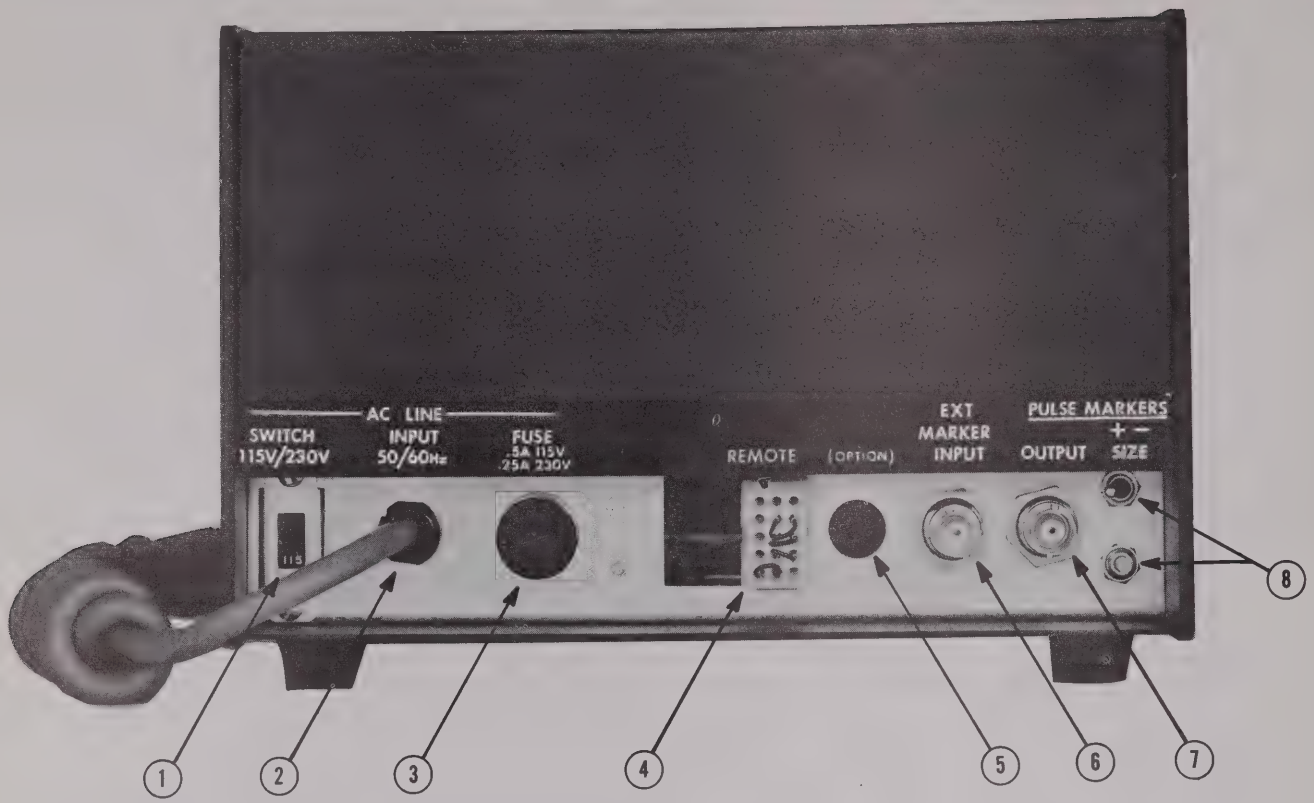


Figure 3-2. Rear Panel

3.3 DESCRIPTION OF REAR PANEL

(1)	SWITCH 115/230 VOLT	Selects 115 or 230 volt line voltage.
(2)	INPUT 50/60 Hz	3 prong AC plug provides connection to AC mains.
(3)	AC LINE FUSE	0.5A for 115 volt AC or 0.25A for 230 volt AC.
(4)	REMOTE JACK	Provides connection for programming of frequency and RF output level. (See paragraph 3-10 for detailed instructions). This jack is supplied with a mating "jumpered plug" which is necessary for Front Panel control.
(5)	OPTION	Mounting hole for a BNC connector.
(6)	EXT MARKER INPUT	BNC connector accepts an externally generated Continuous Wave signal to produce a frequency marker on the display.
(7)	PULSE MARKER OUTPUT	BNC connector provides positive or negative pulse markers when the IF tracking markers (option B) are provided.
(8)	PULSE MARKER ± SIZE	Switch selects either negative or positive marker pulses (option B). Control adjusts the amplitude of the pulses from 0 to over 30 volts.

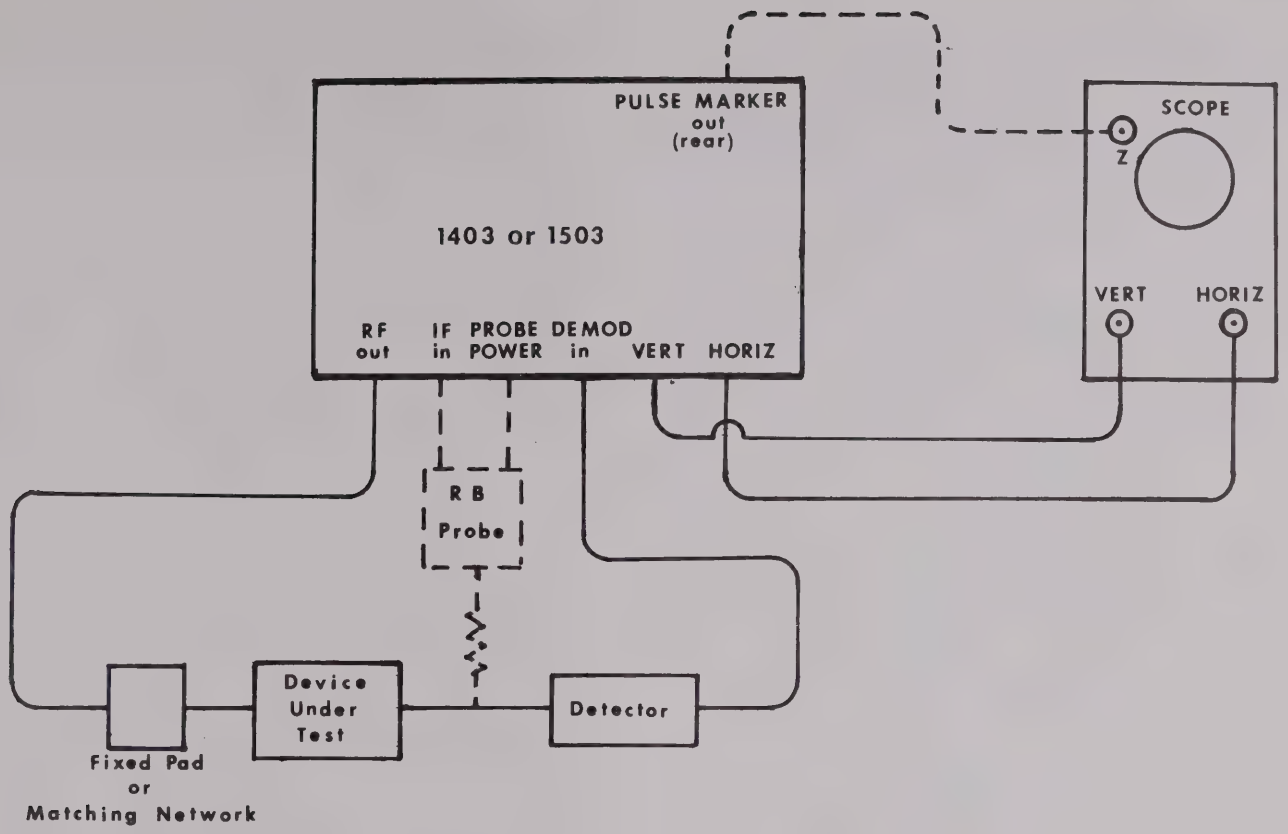


Figure 3-3. Typical Operating Set-Up

3.4 TYPICAL OPERATING SET-UP

When initially setting up the instrument, first check Rear Panel AC LINE VOLTAGE Selector Switch and Fuse to insure that the instrument is set for operation with the available AC mains.

Make connections between the sweep generator, the device under test and the oscilloscope as shown in Figure 3-3. Since hum, RF leakage, and spurious signal pickup must be kept at a minimum, it is essential that good connections and grounds be maintained throughout the entire set-up. Coaxial cables with BNC type connectors should be used whenever possible.

The dashed connecting lines in Figure 3-3 are used in conjunction with the IF tracking feature and will be discussed in the following paragraph, 3.5.

The cable between the RF output and the input to the device under test is especially cricital. It should match the output impedance of the generator and be as short as possible (under 3 feet). An output impedance of 50 Ω is standard at UHF (model 1503) and an output impedance of 75 Ω is standard at VHF (model 1403); however, an output impedance of 75 or 50 Ω can be furnished on either instrument as an option.

The second requirement is that this cable be terminated in it's characteristic impedance. This insures a constant amplitude input signal to the device under test. If the nominal input impedance of the device under test is the same as the cable impedance but has a high VSWR, a fixed pad (normally between 6 to 10 dB) can be installed as shown in Figure 3-3 to mask this input mismatch. If the input impedance of the device under test is not the same as the cables impedance, a matching network is used.

This matching network can be either a resistive or transformer matching network. While the resistive matching pad is simple to construct, it provides more insertion loss than the balun type transformer. Figure 3-4 shows schematics for several resistive pads. The leads connecting the 300 Ω output from the pad to the tuner input should be as short as possibel, under 1".

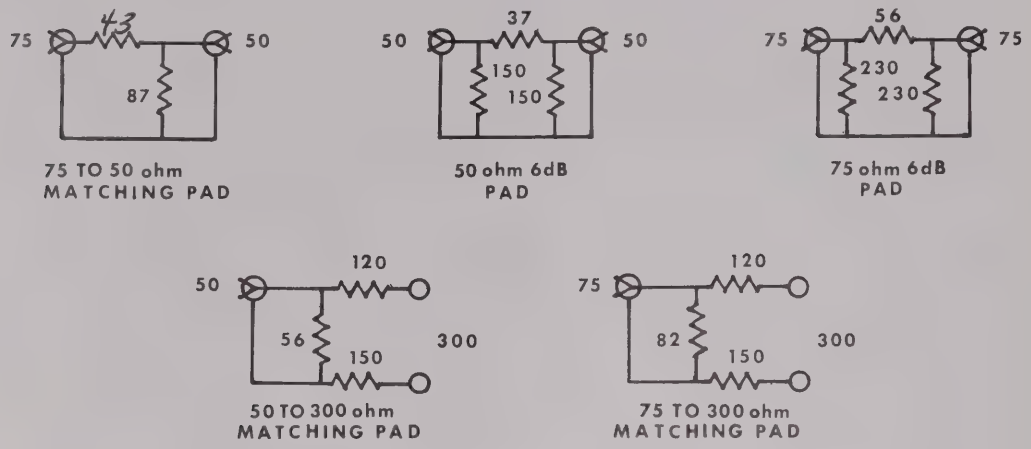


Figure 3-4. Typical Resistive Pads

After the RF swept signal passes through the RF circuits of the device under test, it must be detected (demodulated) before being connected to the DEMOD IN connector. In the case of the TV receiver alignment, the detector is already provided as a part of the receiver, while in aligning a tuner an external detector must be used. Figure 3-5 shows a typical detector.

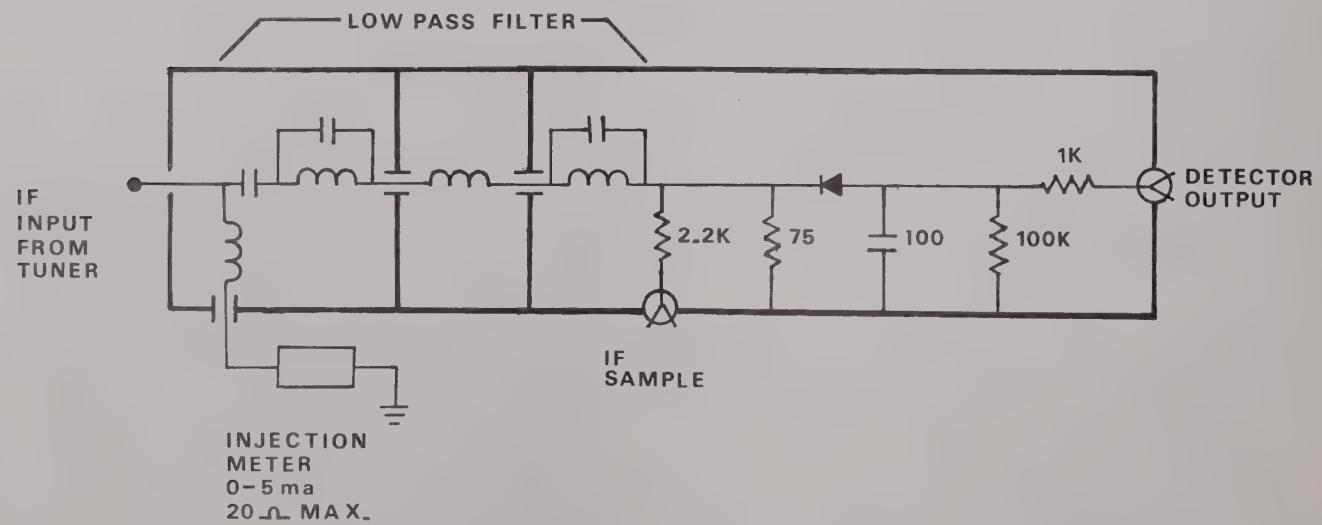


Figure 3-5. Typical Detector

The device indicated as "RB PROBE" in Figure 3-3 is only used when insufficient IF sample is provided by the 2.2K Ω IF sample resistor shown in Figure 3-5. Its use is further explained in Paragraph 3.5.

A second probe is also available (MODEL R6) which combines a wide band IF amplifier with a detector similar to that shown in Figure 3-5. It is used when the unamplified detector output is less than 10mV. Its use is explained further in Paragraph 3.7.

After completing the set-up, switch the POWER ON. The lamp should light, indicating an operating condition. This instrument requires no warm-up and is read for immediate use. Turn both AUTO switches to their manual position and adjust the Sweep Generator controls for the required Center Frequency, Sweep Width, and Output Amplitude. Turn on the desired markers and adjust the marker amplitude and width as needed.

Under certain conditions, the scope response curve may not accurately represent the device under test. Three such conditions, signal distortion from input overloading, radiation and ground loop hum pick-up at low signal levels, and horizontal sweep circuit interference from the receiver under test are discussed in the following paragraphs.

The use of excessive input signals to the device under test can cause overloading. To assure that this condition is not present, and that the response is a true representation of the device under test, turn the ATTENUATION controls to minimum output amplitude. Gradually increase the output amplitude until a response is obtained. A further increase of the output amplitude should not change the configuration of the response envelope except in amplitude. If the response envelope does change, such as flattening at the top, decrease the output just enough to restore the proper configuration.

When making measurements at low levels, radiation and ground loops become problems. Using double shielded cables for carrying RF signals helps minimize the radiation problem. Ground loops causing hum pick-up can sometimes be eliminated by completing only one ground connection between each instrument. This applies particularly to the scope horizontal input. If the ground connection is made at the vertical input terminal, an additional ground at the horizontal input terminal will often result in hum pick-up.

When testing a completed TV receiver, interference from the horizontal sweep circuit of the receiver may appear on the response curves making it difficult to observe a clearly defined trace; therefore, it is recommended that the sweep circuits be disabled during alignment.

3.5 OPTION "B" IF TRACKING FEATURE

The purpose of this feature is to provide a method of precisely determining the local oscillator frequency. This is accomplished by producing markers which are related to the IF output signal. This option also provides the input signal to the automatic frequency, "E" option, and therefore must be installed when option "E" is used. This option is contained entirely in plug-in module M7E and can be either factory or field installed.

SET-UP INSTRUCTIONS

For receiver applications, the IF sample is obtained from a low impedance pick-up coil, normally 2-3 turns air wound on a ½" form. The coil is positioned with reference to the receiver's IF amplifier until sufficient signal pick-up is obtained.

For tuner applications, the IF sample is typically obtained from a high impedance source such as the 2.2K Ω resistor shown in Figure 3-5. This circuit will provide sufficient IF sample to produce IF tracking markers when the detected out-

put signal is over 5 millivolts. If the expected detector signal is 50 millivolts or more, satisfactory performance can be expected without the addition of the IF amplifier probe. If the expected detector signal is less than 50 millivolts, the model RB probe should be used. This will produce markers with a detected signal of approximately .5 millivolts.

It is especially important to provide sufficient IF sample if the automatic frequency option is also installed, since this option provides the control signal to the automatic frequency "E" option.

The input adjustment control on top of the M7E module should be set completely clockwise. Because of the large AGC range of this module, this control seldom requires further adjustment.

Make connections as shown in the dash lines of Figure 3-3. Adjust the PULSE MARKER "polarity" and SIZE controls on the rear panel to produce the desired intensity modulation on the oscilloscope trace.

An alternate method of displaying the IF tracking markers is as differentiated vertical pulses. For this method, the connections from the rear panel pulse output to the scope intensity input are omitted. The front panel MARKER SIZE control is adjusted to provide the desired RF birdy marker amplitude and the PULSE SIZE control located on the M5D module (See Figure 3-6) is adjusted in a clockwise direction until the desired IF pulse marker amplitude is obtained.

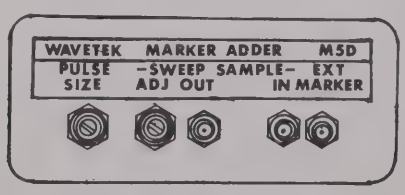


Figure 3-6. Top View M5D

The front panel MARKER SIZE control will now simultaneously adjust the amplitude of the RF birdy and the IF pulse markers. The PULSE SIZE control on the M5D module should be turned completely counterclockwise when the intensity markers are used.

3.6 OPTION "E" AUTOMATIC FREQUENCY

This feature provides automatic frequency tracking of the sweep generator to the device under test, for greater alignment efficiency. This is accomplished by sampling the combined frequency and sweep program voltage for the duration of an IF center frequency marker. The sampled voltage becomes the frequency program voltage for the next sweep cycle, thus keeping the response centered on the display. This feature is contained entirely in plug-in module M11E and can be either factory or field installed.

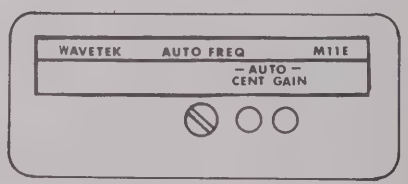


Figure 3-7. Top View M11E

SET-UP INSTRUCTIONS

First, option B, the IF tracking feature, must be installed and IF markers present on the display. Set the front panel AUTO frequency switch to AUTO. Two adjustments are provided on the M11E module (See Figure 3-7) to center the IF markers to the center of the oscilloscope display. The "CENT" adjustment centers the display when the sweep generator's frequency is approximately mid-band (150 MHz/1403, 700 MHz/1503). The "GAIN" adjustment centers the display when the sweep generator's frequency is at its extreme low or extreme high end of the range.

3.7 OPTION "C" AUTOMATIC LEVEL FEATURE

The purpose of the automatic level feature is to maintain the scope pattern at a constant amplitude regardless of the gain variation of the device under test. This is accomplished over a 20 dB range by controlling the 0 to 20 dB PIN diode RF level control in a closed loop system. The automatic level option is entirely contained in plug-in module M8E and can be either factory or field installed. When the automatic level option is not provided, an "M8" module base is installed to complete the marker adder circuit.

SET-UP INSTRUCTIONS

First, the desired operating level of the device under test must be established. This is generally determined by engineering specifications. The detected output from a typical UHF tuner without IF amplification is in the order of 10mV while the output from the IF second detector can be several volts. This feature can accomodate detector outputs between 10mV and 1V of either positive or negative polarity. For detector outputs of less than 10mV, additional gain must be added between the detected output and the instrument's DEMOD input jack. Increasing the sensitivity of the "C" option input, however, results in an increase in the noise level of the demodulated response and also makes the test set-up more susceptable to stray signal and hum pick-up. More success in testing of low level tuners has been achieved by installing a well designed wide band RF amplifier in the tuner test fixture between the tuner IF output and the RF detector. The Wavetek model R6 probe can be used for this purpose. If the detected output is more than 1V, a simple resistive voltage divider can be used to reduce the detected output voltage to the 1V MAX level. All operating and set-up instructions contained in paragraphs 3.2, 3.3, and 3.4 apply.

Temporarily connect the detector output directly to the scope vertical input and, with the instrument operating in the *manual* mode (both AUTO switches down); adjust the ATTENUATOR and LEVEL controls to obtain the desired detector output from the device under test. Once set, do not disturb these controls until the M8E gain controls have been adjusted. Reconnect the detectors output to the DEMOD input and the scope's vert input to the SCOPE VERT out connectors. Set the scope's vertical sensitivity controls for .2V per division (DC coupled). Remove the instrument's top cover and locate module M8E; refer to Figure 5-15 on page 5-14. Adjust the M8E POLARITY switch to obtain a positive scope pattern and the X10 switch and the VAR control to obtain a pattern height of 1V; see Figure 3-8 and Figure 3-9. Finally, switch to Automatic Level Operation, (front panel AUTO Level switche up) and adjust the step ATTENUATOR until the output level indicator reads approximately .5V or less; the vernier LEVEL control is now inoperative.

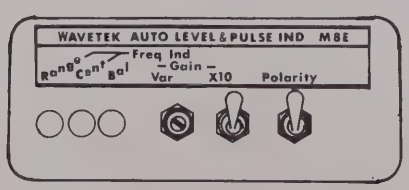


Figure 3-8. Top View M8E

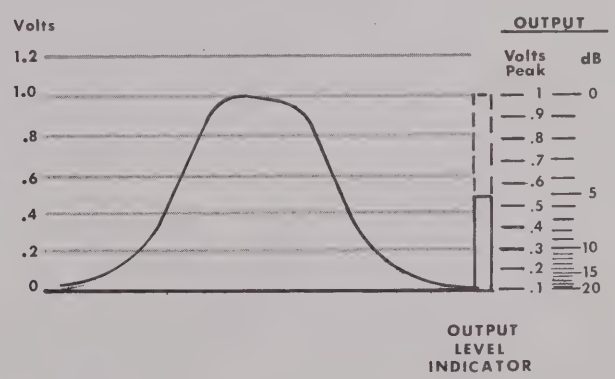


Figure 3-9. Level Indicator

As the gain of the device under test changes from channel to channel, the height of the output level indicator will

vary, indicating the RF output change required to maintain the pattern at a 1V level. The indicator is a linear indication of the RF output voltage over a 20 dB range. A zero volt pedestal level indicates a RF output of .1V peak and a one volt level indicates a RF output of 1V peak. The scope's graticule can be calibrated in volts, dB or indicate minimum or maximum gain points as desired.

3.8 OPTION "C" SCOPE FREQUENCY INDICATOR

In addition to the automatic leveling circuit and level indicator, module M8E contains a frequency indicator circuit. This circuit provides a narrow pulse on the baseline whose position is linearily related to the output frequency. The scope graticule can be calibrated in frequency as desired.

Two controls are provided to calibrate the position of the pulse as related to the baseline. The controls are shown in Figure 3-8. The "CENT" control is used to adjust the position of the indicator when the instrument is operated at its mid frequency point, 150 MHz-1403 or 700 MHz-1503. The "RANGE" control adjusts the amount of travel to the left and right of this position and is used to adjust the position of the indicator at the extreme low and high frequency points. *Once calibrated, any change in the scope's horizontal position or sensitivity controls will change the calibration.*

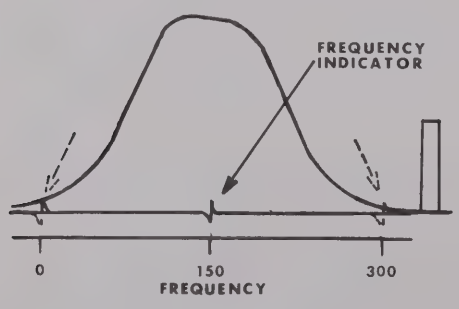


Figure 3-10. Frequency Indicator

3.9 COMBINATION 1403/1503 OPERATION

Figure 3-11 shows the typical set-up to provide combination 1403/1503 operation.

The two remote Rear Panel jumpered plugs are removed and substituted with a special combining plug harness assembly (part number K106). This assembly also contains a VHF/UHF change switch. The plug adjacent to the VHF/UHV change switch is connected to the rear panel REMOTE jack of the unit designated as the "MASTER". This can be either the 1403 or 1503. The remaining plug is connected to the REMOTE jack of the "slave".

Both the instruments have the desired RF marker "A" options. The MASTER unit also has the IF tracking marker, "B" option, Automatic Level and Scope Indicator, "C" option, and the "E" option, Automatic Frequency, installed. For automatic operation, the slave unit cannot have option "C" and "E" installed. The slave unit may have a "B" option installed but it would not function since there is no IF input.

The phase of the ac line must be the same to both instruments. If not, reversing one of the ac plugs will correct the phase.

Set-Up and Operation of the instruments is identical as previously described with the exception of the additional external VHF/UHF selector switch. The AUTO switches, and the FREQUENCY and vernier LEVEL controls on the slave unit are inoperative, but can be controlled by their counterpart located on the MASTER unit. Although the AUTO frequency switch on the SLAVE unit is inoperative, it must be left in the AUTO position for proper automatic operation.

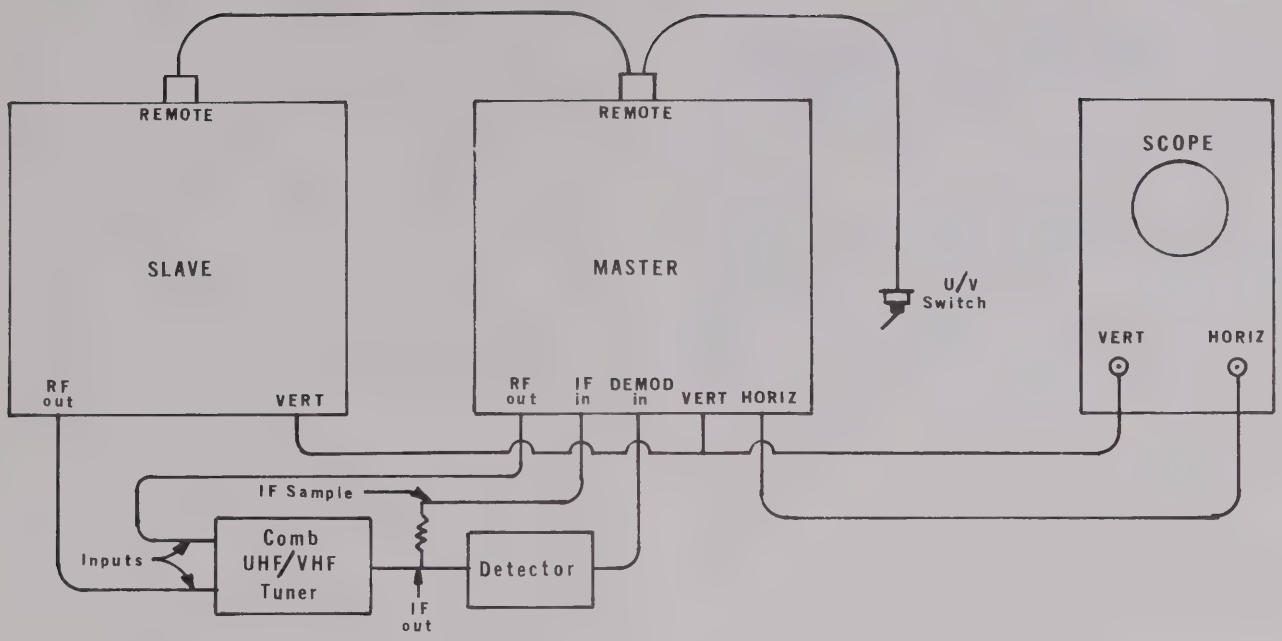


Figure 3-11. Typical Set-Up for Combined 1403/1503 Operation

The schematic of the combining harness is shown below.

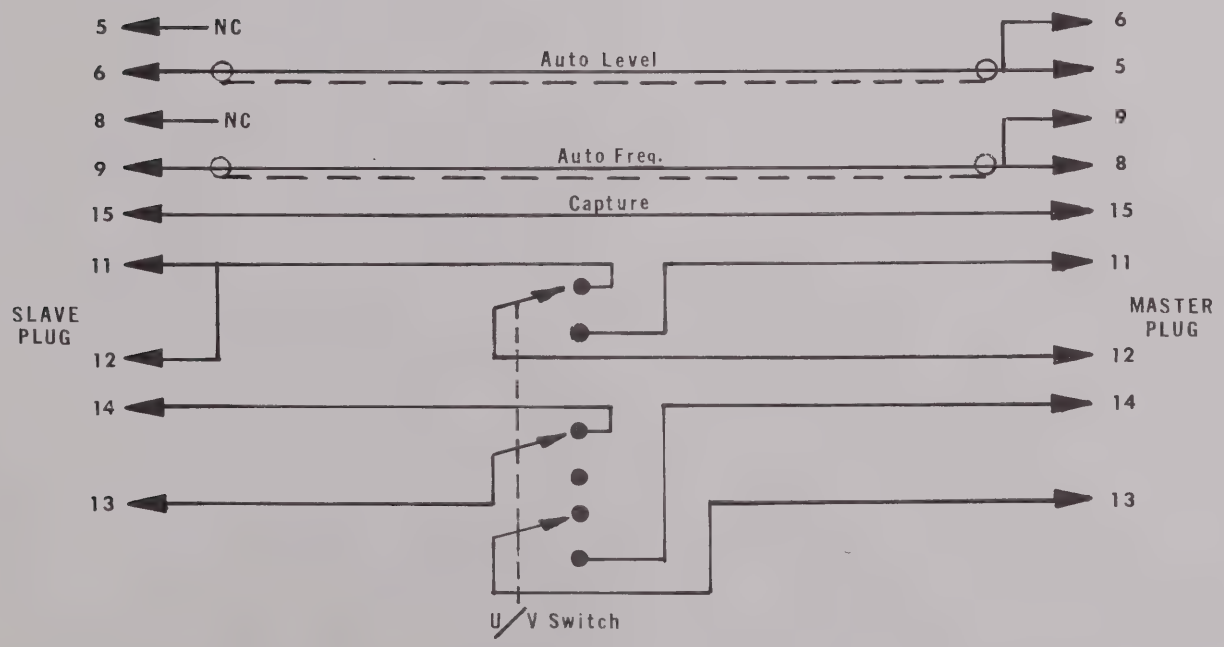


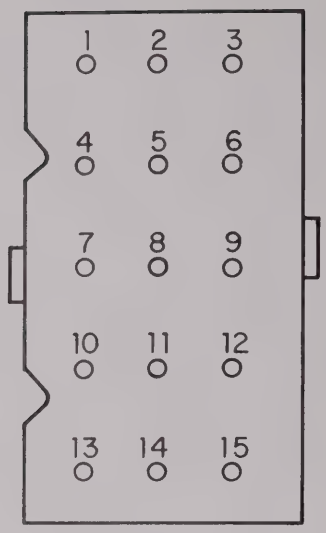
Figure 3-12. Combining Harness Schematic (K106)

3.10 PROGRAMMING

A rear panel REMOTE connector contains the necessary connections for remote control of the center frequency, sweep width and the 0 to 20 dB level control.

The wiring of this connector is shown on the MODULE WIRING DIAGRAM contained in SECTION 6. The jumper wires between pins 8 to 9, 11 to 12 and 5 to 6 provide internal control of frequency, sweep width and output level. Removing these jumpers and wiring external controls as shown on the MODULE WIRING DIAGRAM will provide remote control of these functions.

The additional pins, 13, 14, and 15 are required to provide combination 1403/ 1503 operation as described in paragraph 3.9.



Rear Panel
Remote Jack J 101

Figure 3-13

SECTION 4
CIRCUIT DESCRIPTION

4.1 INTRODUCTION

This section first presents an overall block diagram analysis followed by a more detailed description of each module.

Before beginning the actual circuit description, it would be well to consider the mechanical arrangement of the instrument. This will enable the following block diagram and circuit description to be associated with its physical position, thereby, providing a better understanding of the overall instrument. The mechanical arrangement can be seen by referring to Figure 5-15 in the Maintenance section. This TOP VIEW shows the Front Panel, plug-in module and the rear chassis Power Supply sections.

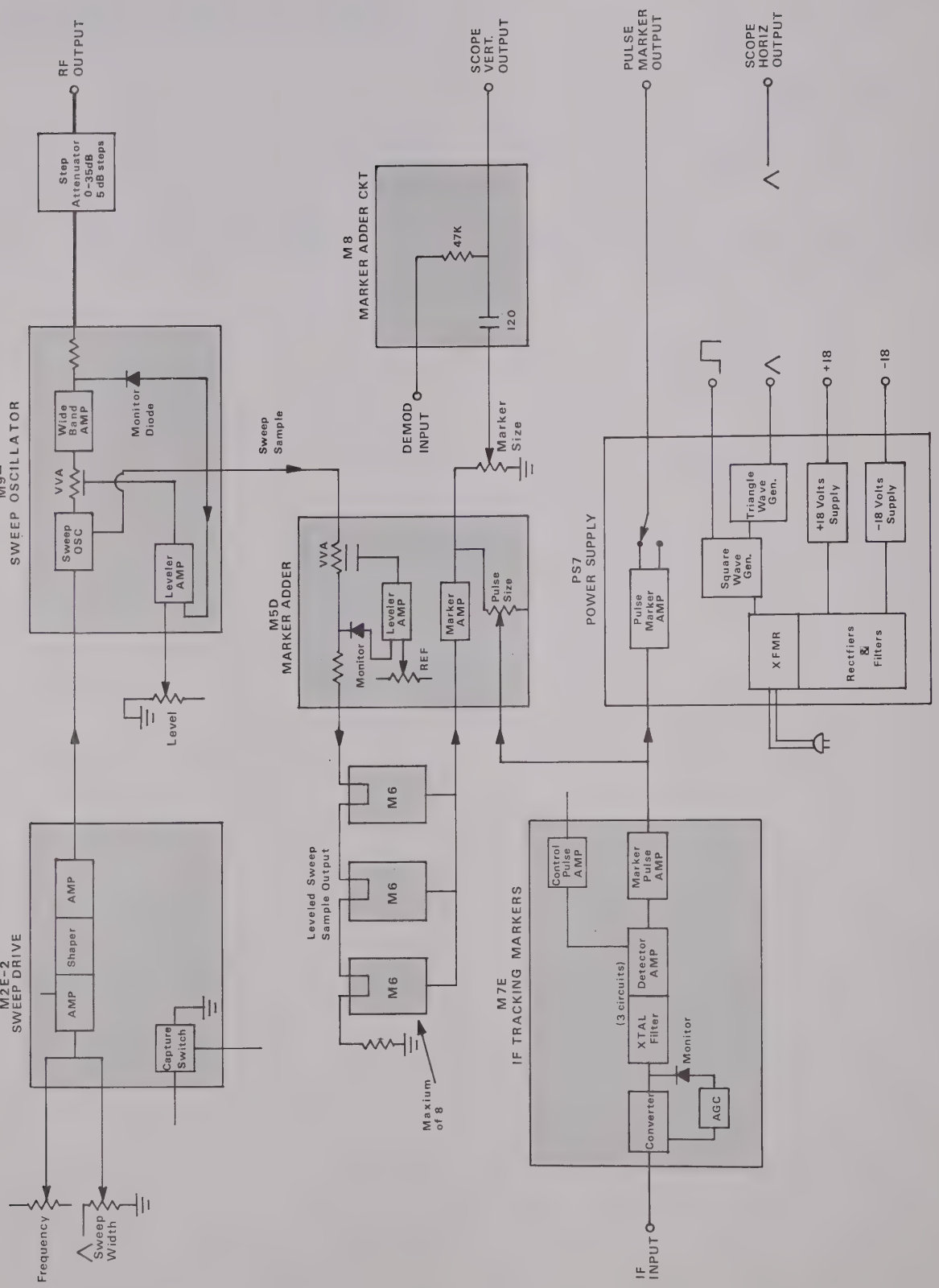


Figure 4-1. Simplified Block Diagram (Manual Operation)

4.2 SIMPLIFIED BLOCK DIAGRAM

The block diagram in Figures 4-1, 4-2, and 4-3 contain both block and module information. The blocks contained within each module are indicated by the shaded area. Figure 4-1 depicts the basic Sweep Generator and Marker circuits in manual operation. Figure 4-2 depicts the circuits required for Automatic Frequency tracking operation. Figure 4-3 shows the Automatic Level control and Scope Indicator circuits.

4.2.1 Manual Operation Diagram

The Power Supply provides two regulated voltage sources, +18 and -18V; and Square and Triangle wave generators for connection to the plug-in modules. It also includes a Pulse Marker amplifier circuit.

The two power supplies provide the voltage to the Front Panel FREQUENCY control, while the triangle wave generator supplies the Sweep ramp to the front panel SWEEP WIDTH control. The output signal from the FREQUENCY and Sweep Width controls are then fed to the sweep drive circuits in the M2E-2 module where they are combined into a single signal which drives the Frequency Determining Varactor Diodes in the Sweep Oscillator module. Necessary level shifting, shaping, and amplitude control is provided by the sweep drive circuit.

The square wave generator blanks the RF output and marker circuits off at retrace and controls the timing of other circuits in the instrument.

The RF sweep generator circuits for the model 1403 are contained in an M9JA module containing the Sweep Oscillator, Voltage Variable Attenuator, Wide Band Amplifier, Monitor, and Leveling Amplifier.

The sweep signal is generated by hetrodyning a UHF sweep oscillator with a UHF CW reference oscillator in a diode mixer. The resultant difference signal is then amplified in a wide band preamplifier, connected through the voltage variable attenuator to the wide band amplifier and then to the monitor point.

Leveling of the RF output is accomplished by the monitor diode which measures the RF voltage and compares it to a reference voltage supplied by the vernier output control. Any error between the two voltages is amplified in the leveler amplifier and is then connected to the Voltage Variable Attenuator at the input of the final wide band amplifier. This closed loop system maintains a constant amplitude RF signal at the monitor point, which compensates for amplitude variations in the sweep oscillator, mixer, and amplifier circuit and also creates a zero impedance. A 75 Ω resistor is connected between the zero impedance point and the RF output system.

The output from the M9JA module is then connected through the turret step attenuator to the front panel RF output connector.

The RF sweep generator circuits for the model 1503 are contained in an M9S-1 sweep oscillator module. The module contains a high level Sweep Oscillator, a Voltage Variable Attenuator, Monitor, and Leveling Amplifier. The output from the sweep oscillator is fed through the voltage variable attenuator to the monitor point. Leveling of the RF output is accomplished in the same manner as previously described and its source impedance is 50 Ω. The output from the module is then fed directly to the turret attenuator without amplification.

The marker circuit is comprised of the Marker Adder module M5D, the individual Marker generators (M6's), and the marker adder function of the M8/M8E module which combines the markers with the scope vertical output. In addition to the marker adding function, the M5D module also provides for leveling of the sweep sample

signal in the same manner as the main RF output signal was leveled. This provides a constant amplitude sweep signal to the individual marker modules, which is extremely important in obtaining a "flat comb" output from the harmonic generating marker modules. It also standardizes the sweep sample amplitude in all instruments, which insure proper operation of field installed markers.

This constant amplitude sweep sample signal is then fed to the individual M6 marker modules where it is combined in a mixer with a crystal controlled CW signal. The resultant difference signal, which is the birdy marker, is then fed back to the marker adder module where they are combined, amplified, and shaped into a single composite signal. This signal is then fed through the marker size control to the marker adder circuit in the M8/M8E module where it is combined with the demodulated input signal. This combined signal is then routed to the front panel SCOPE VERT connector.

When Option C is not used, module M8 is used in place of module M8E. In this module, the DEMOD INPUT is connected directly to the 47k Ω resistor. The marker signals are coupled through the 120pf capacitor to the resistor and to the SCOPE VERT output connector. No other circuits are provided in the module.

The M7E module provides pulse type Local Oscillator Tracking Markers generated from an IF sample derived from a TV tuner or receiver. The Conversion Circuits, which are AGC'd to prevent loss of markers from insufficient IF sample during tuner alignment, convert the IF sample to approximately 10 MHz. (The converted signal generates RF markers in three crystal filters at equivalent converted frequencies.) The Crystal Filter outputs are detected and amplified in identical Detector/Amplifier circuits and are applied to the common Marker Pulse circuit which generates sharp negative going marker pulses.

The Marker Pulse circuit output is routed to the Pulse Marker Amplifier circuit in the PS7 Power Supply, which provides either positive or negative going Pulse Markers at the rear panel.

The Marker Pulses are also fed, through a PULSE SIZE control in the M5D module, to the marker adding circuit in the M8 module where they may be added to the detected response pattern from the DEMOD INPUT jack.

4.2.2 Automatic Frequency Diagram

In Option B, Module M7E, when the Automatic Frequency option is provided, one crystal filter, at the converted equivalent of the IF center frequency is used as an automatic tuning control marker, which is then fed to a separate pulse amplifier. The output of this control pulse circuit is then routed to the Automatic Frequency module M11E.

Option E, module M11E, provides an automatic frequency tuning voltage to keep the tuner response curve centered on the oscilloscope display and is dependant upon the control pulse from the M7E module. The input amplifier provides the required inversion of the signal from the M2E. Its output level at the duration of the control pulse is transferred to a capacitor which retains the voltage for the remainder of the RF on, or Trace time. The timing pulse generator produces a pulse occuring during the first half of retrace time, that transfers this voltage to the reference input of the output amplifier. The output of this voltage follower then becomes the frequency program of the next sweep cycle.

The control pulse from the M7E also charges a capacitor to a high positive level. The first half retrace period pulse transfers this voltage to the M2E-2 capture circuit, holding the FET switches on. If the control pulse did not fire, the capacitor would have had a negative charge derived from a pulse occuring at the second half of the previous retrace

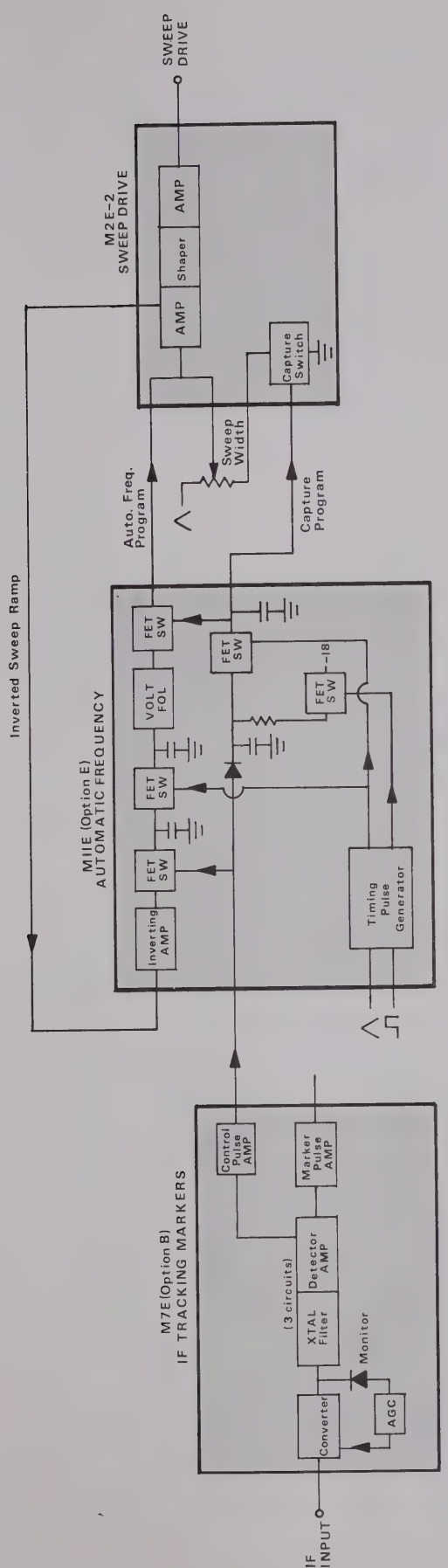


Figure 4-2. Simplified Block Diagram (Automatic Frequency Circuits.)

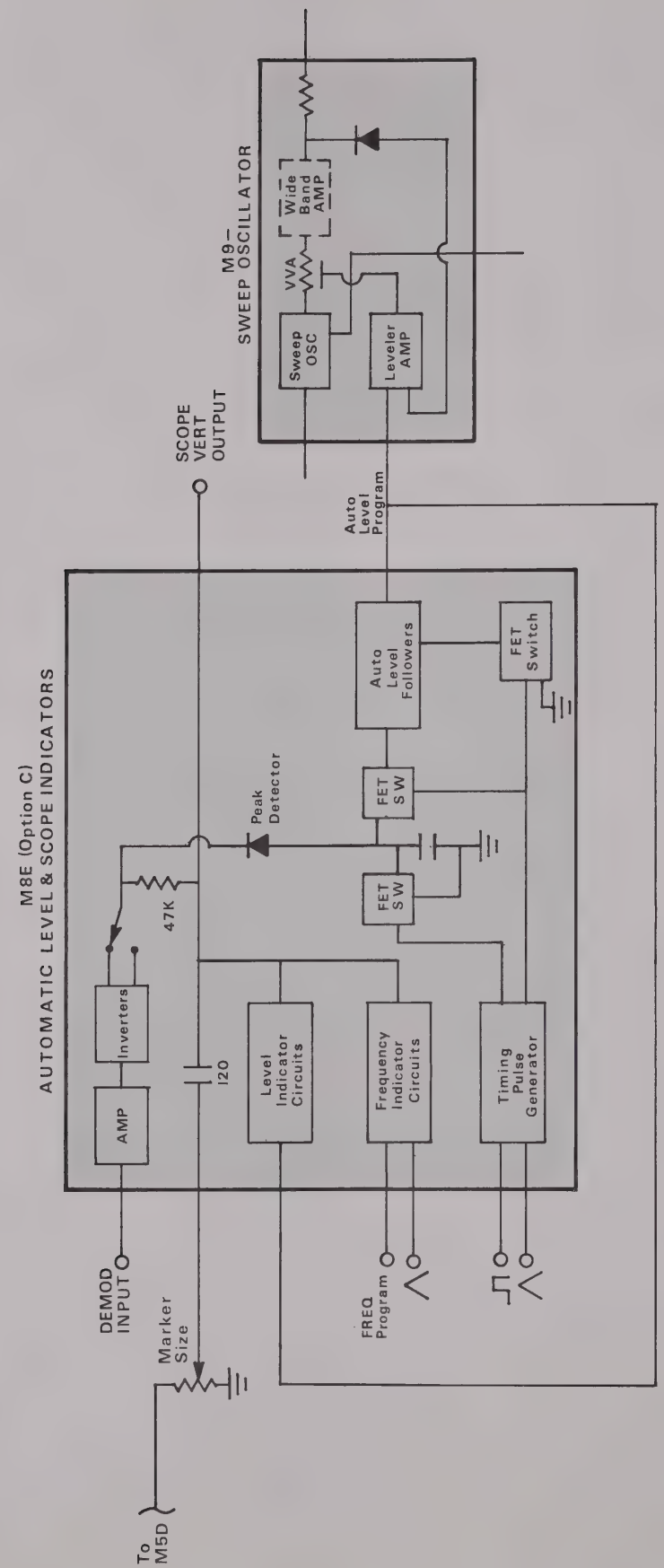


Figure 4-3. Simplified Block Diagram (Automatic Level & Scope Indicators)

period. This negative voltage, when transferred to the M2E-2 capture circuit, turns the FET switches off, thus opening the ground return to the Sweep Width control. The instrument is then in the full sweep width or "capture" mode, essentially searching the full band for the presence of a control pulse.

4.2.3 Automatic Level and Scope Indicators Diagram

The Option C Automatic Level (attenuation) Circuit and Level and Frequency Indicator circuits are contained in an M8E module. The module also contains high impedance, adjustable gain, scope preamplifier circuits, and signal inverters to permit automatic level with either high or low level tuners without using external DC amplifier probes. The level indicator pulse and the marker signals from the Front Panel MARKER SIZE control are combined with the demodulated input signal for connection with the scope vertical or "Y" axis input.

THE FOLLOWING CIRCUIT DESCRIPTIONS ARE REFERENCED TO THE SCHEMATICS APPEARING IN SECTION 6.

4.3 POWER SUPPLY (PS7)

The PS7 power supply provides two regulated voltages, a Square Wave Generator, a Triangle Wave Generator and a Pulse Marker Amplifier.

AC POWER & RECTIFIER CIRCUITS
A dual-primary transformer allows operation at a line voltage of 115 or 230 volts. AC power is supplied through a 3 wire receptacle from the Front Panel ON/OFF switch. The transformer is located away from the sweep drive module to reduce magnetically coupled line ripple. Unregulated pulse and minus voltages are supplied by two full wave rectifier circuits and filtered by C1 and C7. A 12 pin plug, mounted to the printed circuit board, provides access to three unregulated voltages, the regulated +18 and -18 supplies, Square wave and Triangle wave sources and an input to the Pulse Marker Amplifier. R45 is a series voltage dropping resistor for the Power On indicator DS101.

+18 VOLT SERIES REGULATOR
Regulation is provided by IC1 which contains its own internal reference supply. Resistor R9 provides an adjustment to +18.00 volts. An external pass transistor, Q2, boosts the current capability, and transistor Q1 improves the current limiting characteristics of IC1 by providing amplification before limiting. The +18 volt supply is protected against reverse voltage by diode CR7.

-18 VOLT SERIES SHUNT REGULATOR
The voltage reference for this supply is obtained from the +18 volt supply through resistor R20. Resistor R19 provides feedback, applied to IC2, which provides high gain, forcing transistor Q5 to maintain a shunt regulated voltage across resistor R13. Transistors Q3 and Q4 provide the series pass element and are connected as a compound emitter follower so that the voltage across resistor R13 is not loaded heavily. Short circuit protection of transistor Q5 is provided by diode CR8. Current limiting is provided by transistor Q5, when transistor Q6 conducts sufficiently to forward bias diodes CR9 and CR10. Reverse voltage protection is provided by diode CR12.

SQUARE WAVE GENERATOR
The 24 volts AC from power transformer T1 is squared by the comparator IC3A. Diodes CR13 and CR14 provide protection to the inverting input by limiting the voltage range to one volt. The square wave output provides the triangle generator input and is also applied to the base of the Darlington emitter follower Q7. CR15 limits the negative output to one volt. A positive 15 volt, negative 1 volt square wave is routed to pin 10 where it is provided to blank the RF output off during retrace and to control the timing of other circuits in the instrument.

TRIANGLE WAVE GENERATOR
The symmetrical square wave output of IC3A is adjusted by R26 and is AC coupled to the integrator IC3B to restore symmetry about zero. Diodes CR16 and CR6 protect the inverting input by limiting the voltage range to one volt. Capacitor C13 and Resistors R29 and R30, in the feedback network, provide the integrator configuration. This signal, applied to pin 8, provides the sweep ramp, the scope horizontal drive, and controls the timing of other circuits in the instrument.

PULSE MARKER AMPLIFIER
Negative going marker pulses from the M7E (Option B) module in the instrument are routed through pin 7 and AC coupled to the base of the PNP inverter, Q12. The collector signal is DC coupled through the divider network R41 and R42 to the base of the NPN inverter Q13.

Positive going pulses are selected from the collector of Q12, or negative going pulses from the collector of Q13 by marker polarity switch S2, and coupled to the MARKER SIZE control, R44. The pulse is then applied to the marker output jack, J5.

4.4 SWEEP DRIVE (MODULE M2E-2)

The M2E-2 module provides the drive voltage to the varactor diodes in the sweep oscillator module, and when the Automatic frequency option is used, provides an inverted sweep drive ramp to the M11E module. It also contains a capture circuit that causes the sweep width to increase to maximum if a command is provided from the automatic circuitry in the M11E module when the IF input level from the tuner or receiver falls below a specific level.

OSCILLATOR DRIVE
The drive voltage to the sweep oscillator varactors is determined by the programming voltages applied to pin 5 and to pin 7 by the FREQUENCY and SWEEP WIDTH controls. Resistors R3, 4, and 41 divide the Frequency program in half, so that it is equal to the sweep width program. The programs are summed to a standard voltage level in the input amplifier IC1A and then fed to the shaping circuit. The shaping diodes (CR1 to CR5) conduct at levels determined by a variable resistor network driven by a constant current source, Q1. As each diode conducts, an additional current is fed into the summing junciton of the output amplifier IC1B. The output amplitude is set by R31 and the SWEEP WIDTH limit control.

INVERTED SWEEP DRIVE RAMP
The output of IC1A is also fed to the automatic frequency circuits from pin 8, for use as a tuning reference. Since this waveform is adjusted as described in the calibration procedure, it is also noted as test point one (T.P. 1).

CAPTURE CIRCUIT
FET transistors Q4 and Q5 in series with the SWEEP WIDTH ground return, are normally conducting in the manual Frequency mode; and in AUTO Frequency mode, when an IF center Frequency control pulse marker is present. (The transistors are connected in parallel to reduce the conduction resistance, which limits the minimum sweep width, to acceptable limits).

When the tuner IF sample input falls below a level sufficient to generate markers, the automatic circuits provide a capture program at pin 10 that turns the transistors off. This produces a full band sweep width program that overrides the front panel control setting. When the IF response is restored, the capture program which is applied to the gates of Q4 and Q5 is removed, restoring the transistors to full conduction and the instrument to normal automatic frequency operation.

4.5 SWEEP OSCILLATOR, MODEL 1403 (MODULE M9JA)

The RF sweep signal for the model 1403 is generated by hetrodyning the output

of a UHF sweep oscillator with the output of a 1 GHZ fixed frequency (C.W.) oscillator in a diode mixer. The difference frequency in the 1 to 300 MHz range is amplified by wide band amplifier stages. An electronic PIN diode attenuator, providing vernier RF level adjustment, is controlled by a Leveler Amplifier which is regulated by an ALC sense voltage from the monitor diode.

The RF output of the common base configured Fixed oscillator, A1, operating at a frequency of approximately 1000 MHz, is coupled through inductors L2 and L3 to opposite terminals of the double balanced mixer, consisting of diodes CR4, 5, 6, and 7. R14 adjusts the output symmetery of this mixer bridge. Q2 operates at a frequency of approximately 1000 MHz to 1400 MHz. The average frequency is adjusted by resistor R6 which controls the average bias on the cathodes of varactor diodes CR1, CR2, and CR3. The sweep drive voltage from pin 9 of the module is applied to the varactor diodes, decreasing their junction capacitance, thereby causing the oscillator frequency to vary from low to high. The sweep oscillator output is coupled to the other opposing terminals of the double balanced mixer through inductor L4. The resultant difference frequency is then amplified in the 0 to 300 MHz range by the wide band preamplifier stage consisting of transistor amplifier Q4 and emitter followers Q5 and Q8. Transistor switches Q6 and Q7 provide RF blanking by shutting the wide band preamplifier off during sweep retrace time.

Two RF outputs are provided from the WIDE BAND PREAMPLIFIER. One output is coupled via R27 and C15 to a second, similar wide band amplifier stage consisting of Q9, Q10, and Q11. The output of this amplifier is provided at J1 as a sweep sample connection to the marker generating circuits. The second RF output signal is coupled through R26 and C14 to the electronic attenuator consisting of PIN diodes CR1, CR2 and CR3, which provide variable RF conduction proportional to the positive current supplied from the LEVELER AMPLIFIER circuit.

The LEVELER AMPLIFIER, an operational amplifier consisting of Q13 and Q15, provides leveling of the RF output by supplying a positive current to the electronic attenuator system, that is, a positively increasing output voltage from the LEVELER AMPLIFIER will produce an increasing RF output level.

RF blanking is effected by a positive input voltage, from pin 10 to the FET switch transistor Q12, which causes the leveler output to go negative during sweep retrace time, thus shutting off the electronic attenuator. (This effect is re-enforced by the action of Q6 and Q7 in shutting off the preceding wide band amplifier stage.)

The monitor diode, CR13, near the RF OUTPUT jack, provides a negative DC voltage, related to the RF output level present in the RF output system, to the inverting input of the LEVELER AMPLIFIER. Since an increasingly negative voltage at this input will reduce the positive current supplied to the electronic attenuator, the RF output level is held constant, by negative feedback, at a level determined by the reference voltage at the LEVELER AMPLIFIER'S non-inverting input. This reference voltage varies directly with the LEVEL PROGRAM at pin 7. The magnitude of this negative voltage is determined by the LEVEL MAX control, which sets the maximum RF level when the program voltage is maximum. The LEVEL MIN control provides a small negative reference level when the program voltage is zero.

Three Wide Band amplifier stages, Q16, Q17, and Q18 amplify the signal from the electronic attenuator by about 40 dB, with reduced frequency response below 1 MHz and over 300 MHz. Since the closed loop leveling system establishes zero impedance at the monitor point, R8 sets the output impedance at 75 Ω.

4.6 SWEEP OSCILLATOR, MODEL 1503 (MODULE M9S-1)

This module contains an Oscillator, an Electronic Attenuator, a Leveler Amplifier and a Monitor.

Transistor Q1 is a common base varactor tuned oscillator, with biasing of the varactor diodes provided by transistors Q4 and Q5. The B- voltage for the oscillator is modulated by the blanking signal from pin 10 in transistor stages Q2 and Q3. This modulation causes the oscillator to be cut off during the sweep retrace period, thereby providing a zero RF output level during retrace time. The RF signal is coupled from the oscillator to an electronic attenuator consisting of PIN diodes CR1, CR2, and CR3, controlled by the current flowing through the leveler pass transistor Q10. This attenuator is part of the closed loop leveling system also consisting of the monitor diode CR4 and LEVELER AMPLIFIER Q9, Q10, and Q11. CR4 provides a negative DC voltage related to the RF output level present in the output system. This negative voltage is connected to one input of LEVELER AMPLIFIER. The second input of the amplifier is provided by the RF level control. Any error between the two inputs is amplified and used to control the ELECTRONIC ATTENUATOR. This closed loop system maintains a zero impedance constant amplitude signal at the monitor point and allows an adjustment of the signal over a 20 dB range.

The output impedance is provided by the resistor R8 connected between the monitor and the RF output connector.

4.7 MARKER ADDER (MODULE M5D)

The main function of this module is adding together and amplifying the individual marker signals from the M6 marker modules. It also contains the external marker mixer circuit and the sweep leveling circuits.

A low level sweep sample signal, supplied from the sweep oscillator module, M9, is connected to jack J2. This signal is then leveled in the same manner as the RF output signal. The voltage from the monitor diode, CR6, and the reference voltage from R52 is fed to the leveling amplifier consisting of transistor states Q13 and Q14. Q12 provides blanking of the leveling amplifier. Any error between the two input signals is amplified and fed to the PIN diode attenuator CR5. The operation of this circuit produces a constant amplitude signal at the monitor point.

The leveled sweep sample signal is connected to the external marker mixer diode CR1, and to the sweep sample output connector, J3. A 47 Ω resistor, which is connected between J3 and the signal is then routed to each M6 marker module.

The marker output signals from the individual M6 marker modules are connected to the input pins 1, 2, 3, and 4 of the M5D module. One or two M6 outputs are connected to each input. The signals are then amplified in the input stages (Q2, Q3, Q4, and Q5) and combined with the common collector load, comprised of the 33k Ω resistor, R22, paralleled with the choke L1. When the Front Panel MARKER SIZE control is in "push wide", +18 volts applied to the gate of Q6 keeps the FET switch OFF. In PULL NARROW, the +18 volt signal is removed, Q7 is turned on, connecting .033uF capacitor C10 from the compensated collector load to ground, thus reducing the marker bandpass.

The combined marker signals are then amplified in the operational amplifier follower comprised of transistor stages Q7, Q8, and Q9. The amplified signal is then fed to the complimentary output stage Q10 and Q11, which is biased so that input signals less than 0.5 volts are not amplified. This eliminates most spurious markers and noise from the output.

PULSE SIZE control, R40, accepts pulse markers from the IF tracking marker module M7E through pin 8. The pulse markers are combined with birdy markers at pin 7. The combined output is connected to the Front Panel MARKER SIZE control and then to the M8/M8E module and finally to the Front Panel SCOPE VERT connector.

4.8 OPTION "A" MARKERS (MODULE M6'S)

Each marker module contains a crystal Oscillator, a tuned or untuned Mixer and a marker Amplifier. Harmonic generator marker modules also include one or more harmonic generating stages.

Several types of marker modules are required to cover the wide frequency range and to produce both single frequency and harmonic type markers.

A Single frequency marker generator produces a marker at a single frequency while the Harmonic marker generator produces markers at harmonically related frequencies of the crystal oscillator.

The model number for Single frequency markers is M6S followed by the marker frequency. The model number for Harmonic markers is M6H followed by the harmonic marker frequency.

The crystal Oscillator operates between the frequencies of 100 kHz and 55 MHz. Several different types of oscillators are required to cover this range of frequencies. The 17 to 55 MHz oscillators use a tuned Colpitts oscillator with the crystal operating in its third overtone frequency in a series resonant mode. The tuning suppresses the crystal fundamental and higher order resonant frequencies. The crystal and marker frequency are the same for frequencies between 100 kHz and 55 MHz. The markers above 55 MHz use harmonic generating techniques.

The output from the crystal oscillator (or harmonic generator) is combined with the sweep sample in the mixer stage. In the case of single frequency markers, the mixer includes a tuned circuit which selects the desired crystal harmonic frequencies and the sweep sample frequency. In the case of a harmonic marker, the mixer is untuned. The mixer circuit is generally a diode mixer, although transistor mixers are sometimes used. The fundamental and product signals are filtered from the mixer output, leaving the "difference signal" which is applied to the marker amplifier stage.

The marker amplifier is a single stage amplifier having a frequency response of several kHz to approximately 500 kHz. The output of the marker amplifier is connected through the SIZE control to the output pin of the module.

4.9 OPTION "B" IF TRACKING (MODULE M7E)

This module contains a conversion circuit consisting of a bandpass filter, RF amplifier, local oscillator, mixer, 10 to 20 MHz IF amplifier and output Transformer. It also contains an automatic Gain control (AGC circuit), three crystal filters and their associated Detector Amplifier stages, a common Marker Pulse Amplifier and a Reference Pulse Amplifier.

CONVERSION CIRCUIT

The bandpass filter consists of the inductive/capacitance tuned networks at the input to MOS FET Q1. The filter pasaes the frequency band from 30 MHz to 50 MHz. The Q1 stage is an RF amplifier that couples the IF frequencies to one input of mixer Q3. The other MOS FET input receives the 55.75 MHz signal from crystal-controlled Colpitts oscillator Q2. The AGC voltage is also applied to the mixer at this point. The 55.75 MHz local oscillator heterodynes with the output of Q1 to provide output frequencies from 0 Hz to approximately 20 MHz with 10 MHz now corresponding to 45.75 MHz, 12.25 to 43.5 and 14.5 MHz to 41.25 MHz.

The output of the mixer and the following MOS FET amplifier, Q4, drives Pi-networks that are stagger-tuned, in conjunction with the secondary of R1, to provide the required flat response. Frequencies below 10 MHz are attenuated by choke L8. Frequencies above the desired band are attenuated by the low pass filtering of the Pi-networks.

AGC CIRCUIT

A sample of the signal level is coupled from the collector of Q6 to the AGC circuit consisting of monitor diode CR2 and the integrated circuit inverter IC1.

CRYSTAL FILTERS AND DETECTOR AMPLIFIER CIRCUITS

The secondary of T1 is center tapped to provide 180 degree phase displaced signals to the three crystal filters. One crystal provides a 14.5 MHz output for the 41.25 MHz marker, crystal X3 provides a 12.24 MHz output for the 45.75 MHz marker. In each case, the crystal in the filter is selected for a frequency that is the difference between the M7E local oscillator frequency and the desired marker (for U.S. standard sound and video, this is: 55.75 - 41.25=14.5 MHz and 55.75 - 10=45.75).

The crystal filter outputs are nulled for zero output, except at resonance by variable capacitors C30, C32, and C34. These crystal filters provide sharp bursts of RF energy at their series resonant frequencies, detected by CR3 and amplified by Q7. Emitter follower Q8 is a low impedance input to differentiator CR4 which provides a sharp pulse input to the pulse marker amplifier circuits described in paragraph 4.3, and also to the marker adder module M5D.

CONTROL PULSE AMPLIFIER

Emitter follower Q8B provides a second output of a reference pulse amplifier. The first stage, CR5 and Q12, duplicates the function of CR4 and Q9, as described above. The second stage, Q13, amplifies and inverts the pulse. The positive going pulse is then routed through pin 8 to the automatic frequency module M11E.

4.10 OPTION "E" AUTOMATIC FREQUENCY (MODULE M11E)

The M11E module provides two electronic functions. The first is an automatic Frequency tuning voltage to the M2E-2 Sweep Drive module to automatically position the demodulated tuner response in the horizontal center of the oscilloscope display. The second is a Capture command program voltage to the M2E-2 to cause this module to apply a full sweep width program to the sweep oscillator. This insures that, provided the tuner is functioning at all, the IF response will appear somewhere in the band, allowing the automatic tuning function to operate. (This capture initiating voltage appears only when the IF signal level to the M7E module falls below the level required to generate a control pulse marker).

The two option E functions are enabled by three sequential time related pulses. The first of these is a "Control" pulse, derived from the M7E module, OPTION B, which occurs only for the duration of that pulse in RF on or trace time. The second is a "Transfer" pulse, occuring throughout the first half of retrace time, and the third is a "Reset" pulse, which occupies the remaining half of the retrace period.

4.10.1 Automatic Frequency Circuits

The Automatic Frequency circuits consist of: the Inverted Sweep Ramp Amplifier; the Sampling and "Memory" circuit, and the Automatic Tuning Voltage Follower.

INVERTED SWEEP RAMP AMPLIFIER

The inverted sweep drive ramp described in paragraph 4.4, is connected through pin 1 to the inverting input of the integrated circuit operational amplifier IC1A. AUTO GAIN control, R2, which is in both the input and the feedback loop,

effectively adjusts the range, or band limits, of the automatic frequency (tuning) program. The AUTO CENT. control, R4, sets the average DC level (offset) of this input and is, in effect, an automatic tuning program mid-band adjustment.

The same inverted ramp is also applied to the inverting input of the comparator configured operational amplifier, IC2B. The LOW LIMIT, (low frequency cut out) control offsets this input so as to switch the comparator output from the positive to the negative state as the tuning voltage level increases beyond the program for the low frequency limit of the sweep oscillator. The negative comparator output shuts off the FET switch transistor, Q1, which is in series with the IC1A output, thereby preventing the automatic tuning program from ranging more negative. (This circuit is necessary for the automatic operation of the model 1403 so that, when in the capture mode, the automatic circuits will not find and lock in on an "image" IF frequency beyond the hetrodyne zero beat of the sweep oscillator).

SAMPLING & "MEMORY" CIRCUITS
The control pulse from the M7E module, Option B, described in paragraph 4.9 is connected through pin 8 to the gate of FET switch Q2, turning it on. This "samples" or transfers the output voltage level of IC1A during the pulse duration to capacitor C3. C3 stores, and in effect, "remembers" this voltage for the remainder of trace (RF on) time.

AUTOMATIC TUNING VOLTAGE FOLLOWER
The "transfer" pulse, in the first half of RF OFF time (first half of the retrace period) as described in paragraph 4.10.3, switches FET Q3 on, transferring the voltage present on capacitor C3 to C4, which is connected to the FET input voltage follower comprised of Q4, Q5, and IC1B. Protection diodes CR1 and CR2, connected with divider networks R13/R14, and R15/R16, prevent the input voltage from exceeding ± 9 volts. The output voltage is routed through pin 12 to the M2E-2 pin 4, Frequency Program input, as the frequency tuning program for the next sweep cycle.

4.10.2 "Capture" Program Circuit
The "capture" program circuits consist of a control pulse Detector and FET "Capture" switch circuits.

CONTROL PULSE DETECTOR
The +30 Volt control pulse also causes diode CR3 to conduct, charging capacitor C10 to a +18V level. This charge is retained by this control pulse sensing capacitor, for the remainder of the trace period.

CAPTURE SWITCH CIRCUITS
The "TRANSFER PULSE" in the first half of retrace also turns FET switch Q10 on, transferring the voltage present at C10 to C11, and pin 6. This positive voltage keeps parallel FET switches in the M2E-2 module turned on, providing a path to ground for the Front Panel SWEEP WIDTH control, thus maintaining the preset sweep width program. If a control pulse had not charged C10, the switches in the M2E module are turned off, providing full sweep width for the next sweep cycle, or until the control pulse reappears.

FET switch, Q11, is also turned off, disconnecting the Auto tuning program. This causes the Sweep Generator center frequency to return to the center of the band when in the capture mode of operation.

4.10.3 Timing Pulse Circuits

The Timing Pulse circuits consist of a Control Pulse, described in paragraph 4.9; and a Transfer Pulse, and a Reset Pulse described below.

"TRANSFER" PULSE
The triangle wave signal at pin 4 is connected to the non-inverting input of the comparator configured operational amplifier IC2A, which produces a positive rising square wave, coincident with the positive rising zero voltage crossing of the triangle wave input.

The blanking square wave at pin 10 is connected to the emitter of common base configured transistor Q6, which converts it to a square wave that is symmetrical about ground, with collector output now more negative in trace time, and still positive in retrace. When the positive period of IC2A and Q6 coincide during the first half of retrace, neither diode CR4 nor CR5 conduct and their anode voltage rises to a positive level established by the current through R25 as supplied by +18V. This produces a positive "transfer" pulse in the first half of the retrace period.

"RESET" PULSE

Common base configured transistor, Q7, is held off during the trace time by the negative period of the symmetrical square wave, from Q6, at its emitter. Q7 is likewise held off during the first half of retrace by the positive level at its base. In the second half of retrace, CR4 conducts, driving the base of Q7 negative and turning it on. The resultant positive discharge pulse is connected through FET emitter follower Q8 to the base of Q9, turning it on and discharging any positive voltage present on C10 to -18 volts, thereby resetting this control pulse sensing capacitor for the next sweep cycle.

4.11 OPTION "C" AUTOMATIC LEVEL & SCOPE INDICATORS (MODULE M8E)

The M8E module provides adjustable 100 to 1 gain to the demodulated input from the front panel, selectable polarity inverting circuits and an RC network for adding markers to this demodulated signal. It primarily provides an automatic RF level (attenuation) DC voltage to the M9 Sweep Oscillator leveler reference input, automatically adjusting the RF output level to a value that will maintain a constant amplitude demodulated tuner response. The module also provides oscilloscope indications of the RF level program by means of a vertical pedestal or pulse on the retrace base line, whose amplitude varies directly with the RF level program amplitude, and of the frequency (tuning) program by means of a narrow differentiated pulse that moves across the base line in step with the tuning voltage program in ascending frequency from left to right.

DEMODULATED INPUT AMPLIFIER

The demodulated response of the tuner under test is fed from the DEMOD INPUT jack to pin 8 and is AC coupled to the FET input voltage follower comprised of transistors Q1 and Q2 and section A of the integrated circuit operational amplifier IC1. Diodes CR1 and the divider network R8 to R11 provide input gate protection. VAR GAIN potentiometer in the feedback network adjusts the amplifier gain. The output signal is applied to the low gain (X1) contact of switch S1 and to the "B" section of operational follower IC1, which is set to a ten to one voltage gain. The 100 to 1 step and vernier gain adjustment are provided so that automatic RF level control may be used with both high and low level tuners, without using external active DC probes.

POLARITY INVERTING CIRCUITS

The Signal at the common contact of X10 GAIN switch, S1, is capacitively coupled to the voltage follower comprised of FET transistors Q3 and Q4 and operational amplifier IC2A. Q5, which saturates when the positive blanking square wave is applied to its base, is provided to remove unwanted noise at RF off time and BAL control, R14, adjusts for zero volt base line trace. The output signal is applied to the (inverted) contact of POLARITY switch S2 and to the inverting input of IC2B, which is set for a gain of one. The inverted signal is fed to the normal contact of the POLARITY switch. A positive response pattern is selected for the proper operation of the automatic level circuits. This permits the use of detectors of either polarity in the test set-up without requiring the use of external polarity inverting amplifiers.

MARKER ADDING CIRCUIT

The signal at the common contact of the POLARITY switch is fed through R27 and pin 9 to the Front Panel SCOPE VERT output jack. Markers from pin 7 are combined with the output signal through C5.

AUTOMATIC LEVEL PROGRAM CIRCUITRY

The AUTO LEVEL feature sensed the demodulated peak response at each sweep cycle, compares it to a pre-set reference voltage and regulates the program voltage to the 20 dB PIN diode attenuator so as to maintain the tuner response at a one volt level. This function is enabled by two sequential time related pulses. The first is a sampling pulse occuring during the first half of retrace time, the second is a discharge pulse which occupies the remaining half of the retrace cycle.

The positive response at the common contact ot the POLARITY switch is also peak detected by CR6 and retained by C22. The RF blanking square wave from pin 10 is level shifted to nearly symmetrical about ground through Q8. The Triangle wave at pin 4 is applied to the non-inverting input of the comparator configured operational amplifier IC4A, producing a positive square wave in the half cycle when the triangle wave is positive with respect to ground, which is the last half of the trace period and the first half of retrace. When both the signal at the collector is Q8 and at the output of IC4A is positive. diodes CR4 and CR5 do not conduct. The voltage at their anodes is then pulled to +18 volts through R49, producing a positive pulse occuring in time during the first half of retrace. This pulse, by turning FET Q11 on, transfers the voltage on C22 to C23, which retains the voltage for the duration of the sweep cycle at the input to the voltage follower consisting of FETS Q12, Q12, and IC7A. The output signal at IC7A, pin 1 is connected through the 10:1 divider, R75 and R76, to a second voltage follower consisting of Q16, Q17, and IC7B.

The output of IC7B is fed through Zener diode CR8 to the base of the uto level output emitter follower, Q18. Since this program voltage will vary between -18 and 0 volts, Q18 is supplied from -30 volts. The 1k Ω resistor R88, in series with the collector, provides current overload protection. When the demodulated output voltage exceeds one volt, the response at the common of S2 causes the common base configured transistors Q14 and Q15 to conduct, turning FET switch Q19, on. This inserts R84 in the IC7B feedback loop, increasing the regulation response, and quickly adjusting the automatic level program.

During the last half of the retrace cycle, peak detector capacitor, C22, is discharged thru FET Q10. This action is initiated by a positive pulse overriding the normal negative bias on the gate of Q10. The pulse is produced by the switching action of transistor Q9, due to the coincidence of the positive blanking pulse at the emitter and a negative voltage at its base during the second half of retrace.

In brief, the demodulated tuner response is sensed as a positive voltage, referenced to produce a 1 volt peak response on the scope display. For example, when more than one volt (in effect) is sensed, the AUTO LEVEL circuit produces a proportional positive change in the RF LEVEL program to reduce the RF output.

RF LEVEL INDICATOR PULSE CIRCUITRY

The RF Level Program is fed to pin 6 and applied to the inverting input of operational amplifier IC3B, which is connected so as to convert the -18 to 0 volt RF level program to a +1 to 0 volt program when it is combined with the demodulated output signal at the junction of R27 and pin 9.

The RF Blanking Square Wave from pin 10 is differentiated by capacitor C8 and resistor R32 and is applied to the base

of transistor Q6. Q6 inverts and amplifies the positive rising leading spike derived from the start of retrace (RF off) time. The negative going pulse output from the collector of Q6 is differentiated by C9 and R34. The negative going leading spike is used to trigger the integrated circuit timer, IC5. This trigger sets a multivibrator, which releases a short circuit around capacitor C10. C10 charges to a positive voltage at an exponential rate determined by the RC time constant of the capacitor and R35. When C10 has charged to 2/3 of the timer's B+ supply voltage, the multivibrator resets quickly discharging the capacitor. The timer output is less than ¼ volt positive before it is triggered and over 10 volts positive during the charging time of C10. The high positive voltage overrides the negative bias on the gate of the FET switch transistor Q7, turning it on. When Q7 conducts, the converted level program voltage at R39, described earlier, is transferred to pin 9. The result is a vertical pedestal pulse on the retrace base line located at the extreme right side of the scope display, with the pulse amplitude pulse indicating the RF output.

FREQUENCY INDICATOR PULSE CIRCUITRY

The frequency (tuning) program at pin 6 is inverted by operational amplifier IC3A, and the inverted program fed to the non-inverting input of the comparator configured operational amplifier IC4B where it varies the average level of (offsets) the adjusted triangle wave voltage from pin 4. FREQ. IND. CENT. control, R43, adjusts the offset level at the comparison point. The comparator output is a positive pulse starting and ending when the adjusted and offset triangle wave equals the ground or zero voltage reference.

The output of comparator IC4B is differentiated by C14 and R48. Diode CR3 removes the positive trace spike. The negative retrace spike triggers the integrated circuit timer IC6, which functions in the same way as the level indicator pulse timer, IC5, described above. The RC time constant of C16 and R50 establishes the duration of the positive pulse output. The timer output pulse is differentiated by C18 and R52 and combined with the demodulated output through R54. Since the timer is triggered by the negative spike only, the frequency indicator appears only on the retrace base line as a narrow, differentiated pulse that moves across the base line in step with the tuning voltage program.

SECTION 5
MAINTENANCE

5.1 INTRODUCTION

This section provides information for testing, calibrating, and trouble shooting the Sweep Generator. The performance test is designed for incoming inspection and periodic evaluation. If performance is not to specifications, refer to the calibration and trouble shooting sections.

5.2 SERVICE INFORMATION

5.2.1 Disassembly Information

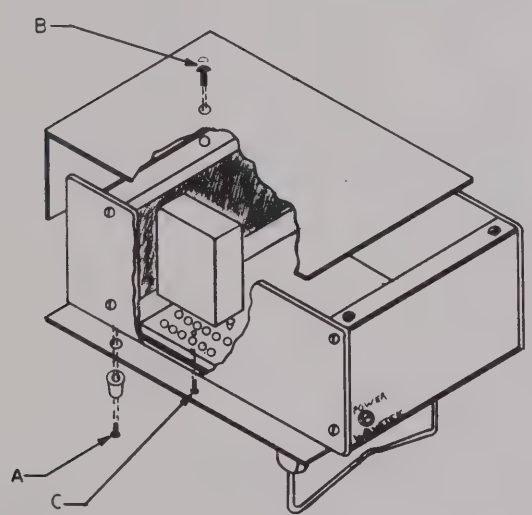


Figure 5-1. Disassembly

REMOVAL OF BOTTOM COVER - Remove the two rear feet (A) and lift cover off with a slight rear movement.

REMOVAL OF TOP COVER - Remove the single screw (B) from the top and lift off cover with a slight rear movement.

REMOVAL OF SIDE PANEL - Either side panel can ge removed to provide better access by removing the four screws holding the side panel to the instrument. The Front Panel/Module Section can be removed from the power supply section by removing two screws holding the sections together and by disconnecting the electrical connectors between the two sections. NOTE: Separation of the two sections performs no useful purpose during normal service procedures.

5.2.2 Module Servicing

SERVICE KIT K102 - This kit contains a module extender and RF extension cables which enables the module to be electrically operated while physically located above the rest of the modules, thereby making all parts easily accessible.

REMOVAL OF MODULE - Modules may be removed by removing any cables attached to the top of the module and removing the hold-down screw (C) from the bottom. Pushing up on the module ball studs will help free the ball studs from the chassis mounted spring clips.

REMOVAL OF MODULE COVER - Remove all nuts and screws from top of module and slide the cover off.

REINSTALLING MODULE - Before reinstalling the module, check the module pins for proper alignment, then carefully seat the module pins into the chassis socket and replace the hold-down screw (C) to ensure a good ground connection between module and chassis.

MODULE PIN-NUMBERING SYSTEM - The module pins are numbered as shown in Figure 5-2. The ball studs for the circuit modules are located off center to prevent the modules being plugged in backwards. This off-center ball stud location also provides a method for locating pin No. 1.

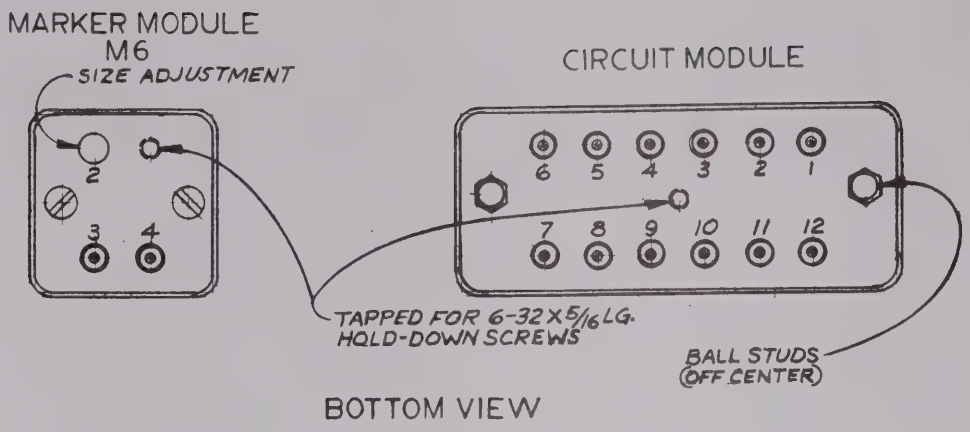


Figure 5-2. Module Pin Numbering System

5.2.3 Tranisitor Lead Configuration - Transistor lead configurations are shown in Figure 5-3.

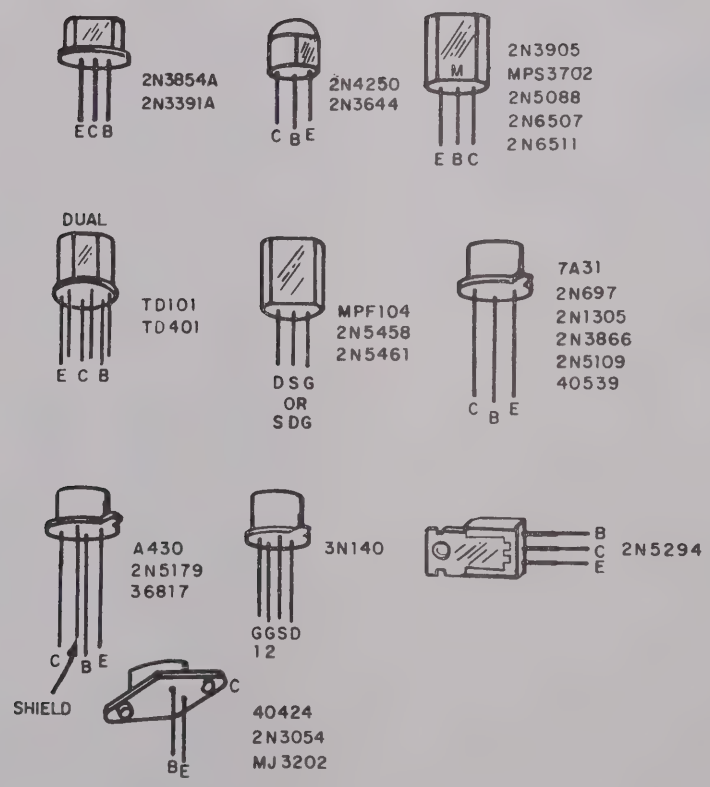


Figure 5-3. Transistor Lead Configuration

5.2.4 Recommended Test Equipment

The following test equipment, recommended for servicing, troubleshooting, and calibrating the Wavetek Model 1403 or Model 1503 is shown in Table 5-1.

TABLE 5-1. RECOMMENDED TEST EQUIPMENT

INSTRUMENT	CRITICAL REQUIREMENT	RECOMMENDED
Oscilloscope	DC coupled 1mV/cm sensitivity	HP-130
Digital Voltmeter	0.1% accuracy	Weston 1240
RF Detector	Halfwave Negative output, flat For 75 Ω units For 50 Ω units	 Wavetek D171 Wavetek D151
Marker Generators For Model 1403	1,10, & 30 MHz Harmonic Markers 150 MHz Single Frequency Marker	Wavetek M6H-1 M6H-10, M6H-30 Wavetek M6S-150
Marker Generators For Model 1503	1, 10, & 50 MHz Harmonic Markers 700 MHz Single Frequency Markers	Wavetek M6H-1 M6H-10, M6H-50 Wavetek M6S-700

5.3 PERFORMANCE CHECKS

The following procedure is intended to insure that the instrument meets its published specifications. The checks specified assume that the instrument is equiped with the marker options specified in Table 5-1, Recommended Test Equipment. While it is possible to check the instrument's performance without the use of harmonic markers, by using suitable external CW sources, a complete check by this method is impractical. The required performance is shown in paragraph 1.2, Specifications. This paragraph is intended to be used in conjunction with the following performance check.

5.3.1 Test Set-Up

Connect the sweep generator, RF detector and scope as shown in Figure 5-4. Adjust the sweep generator controls as follows. FREQUENCY dial to exact center frequency (150 for the 1403 and 700 MHz for the 1503). SWEEP WIDTH to "in" position and fully clockwise (maximum) and the RF output controls for maximum output. Switch the AUTO LEVEL and AUTO FREQUENCY switches to the down (manual) position. When option "C", Auto Level and Scope Indicators, is installed in the unit, replace the M8E module with an M8 module until the basic sweep generator performance checks are complete. Substituting this module will eliminate the need to change the automatic level set-up controls to verify the performance of the instrument.

If this module substitution proves inconvenient in receiving inspection, adjust the M8E GAIN controls for *unity* gain, and the POLARITY controls for *negative* output before proceding. In this instance, it should be noted that the frequency and level indicating pulses will appear on the scope pattern along with the normal demodulated display.

Adjust the scope to operate in an X-Y mode with D.C. coupling on both inputs. Set the vertical sensitivity to 0.2 volts/cm. Set the vertical position, horizontal position, and horizontal sensitivity to obtain a scope pattern similar to that shown in Figure 5-5. Turn on the harmonic marker (30 MHz/1403, 50 MHz/1503). Adjust the marker WIDTH to "in" position and SIZE to produce a marker amplitude similar to that shown in Figure 5-5.

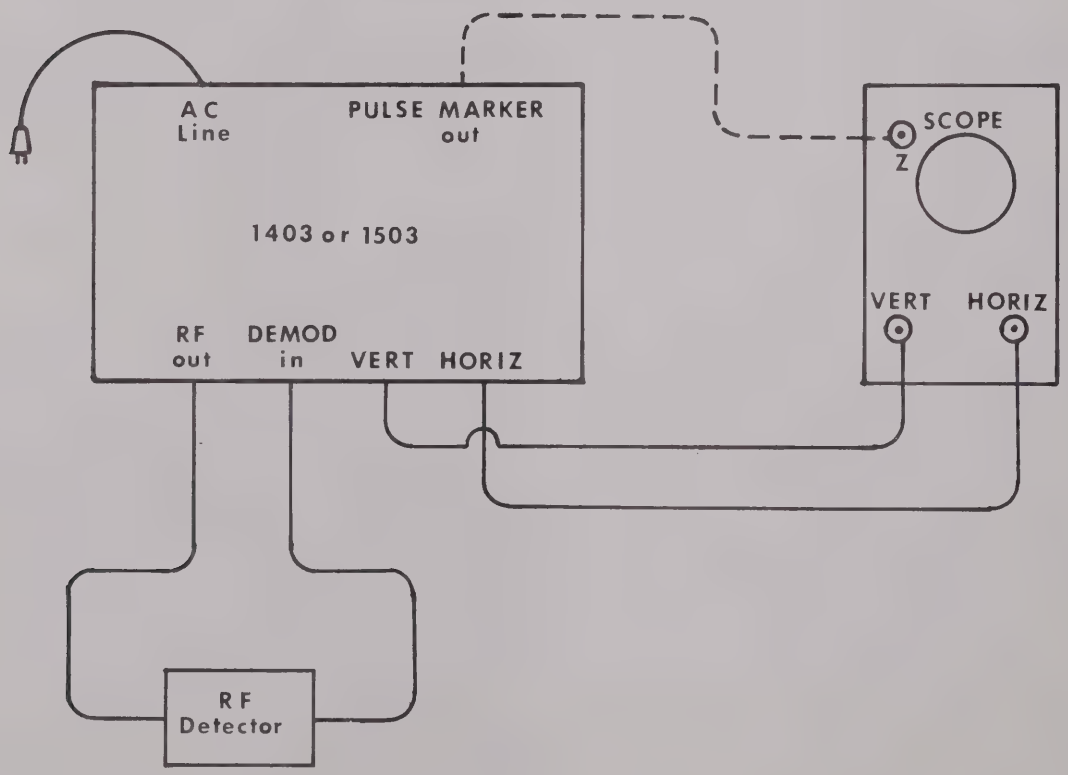


Figure 5-4. Typical Test Set-Up

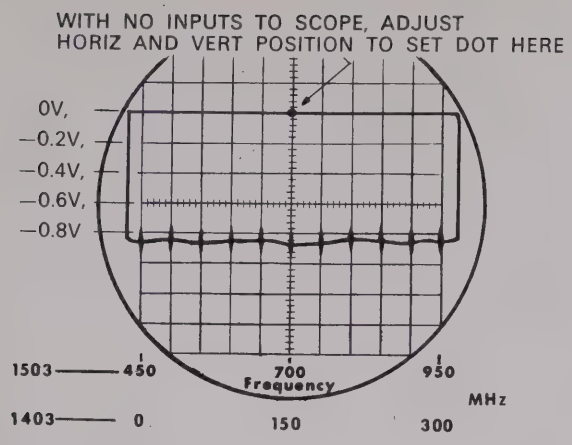


Figure 5-5. RF Detector Display

5.3.2 Frequency Range Check

Turn off the harmonic marker and turn on the center frequency marker (150 MHz/1403 or 700 MHz/1503). A single marker should be present at the exact center of the display. Turn off the single frequency marker and turn on the harmonic marker (30 MHz/1403 or 50 MHz/1503). The scope display of Figure 5-5 verifies the entire frequency range (0 to 300 MHz/1403 or 450 to 950 MHz/1503).

NOTE: The low limit marker on the 1403 is not a marker but the zero lock-in produced by the heterodyne sweep generator technique.

5.3.3 Maximum Sweep Width Check

The maximum sweep width is verified by observing the scope display as shown in Figure 5-5. The maximum sweep width of the 1403 is 300 MHz and the 1503 is 500 MHz.

5.3.4 Display Linearity Check

Display linearity is read directly from the display as shown in Figure 5-5. Each marker must fall within $\pm$0.2 cm from each centimeter line on the graticule, this is equivalent to a display linearity of 2%.

5.3.5 Tuning Range Check

Since the frequency indicated at the exact center of the display as shown in Figure 5-5 is the same as the output frequency when the instrument is operated at minimum sweep width, the center frequency range of the instrument can be checked by simply turning the FREQUENCY control to its extremes and noting the range of frequencies indicated at the exact center of the display. The low and high limit markers should move past the display center line by approximately ½ cm. This represents approximately a 5% overrange capacity.

5.3.6 Minimum Sweep Width Check

Set the sweep width control to the PULL NARROW position and turn to fully counterclockwise (minimum) position. With the 1 MHz harmonic markers turned on, the display will show 5 markers or less. This is equivalent to a sweep width of less than 5 MHz.

5.3.7 RF Output, Maximum Check

Return the sweep width control to maximum. A display amplitude of approximately .8 volts indicates the proper RF output level.

5.3.8 RF Output, Flatness Check

The RF flatness of $\pm$.25 dB is read by comparing the minimum amplitude point to the maximum amplitude point. The difference between these points should be less than 6%.

If either the proper RF output or flatness is not obtained, first check the RF detector, which could be defective. If not, refer to paragraph 5.4.9, Min and Max Level adjustment, in the calibration procedure or paragraph 5.5, Trouble Shooting.

5.3.9 RF Output, Vernier Minimum Check

While observing the scope pattern, turn the vernier attenuator from it's maximum to minimum position. The scope pattern should change smoothly from approximately .8 volts (with step attenuator set to its 0 dB position) to approximately 40mV.

5.3.10 RF Output, Step Attenuator Check

Return the vernier attenuator to its maximum position. Turn the attenuator to its 5 dB position. The output amplitude should decrease approximately in half. The output should continue to half for each additional 5 dB step until approximately 20 dB. After this level, because of the square-law characteristics of the detector, each additional 5 dB step will cause the output to decrease approximately 60 to 70%. The output level at -35 dB will be approximately 2mV.

5.3.11 Scope Horizontal Check

Change the calibration of the scope horizontal sensitivity to 2V/division. The display width indicates the peak-to-peak horizontal output of 16V $\pm$4V.

5.3.12 Option "A" Marker System Check

Readjust the scope horizontal sensitivity to obtain the pattern of Figure 5-5. The following check is for a harmonic marker. Specifications, with the exception of spurious markers, are the same for either single frequency or harmonic type markers and the procedure for verification of performance does not differ. Single frequency markers should have no spurious markers throughout the swept range. Harmonic type markers may or may not have small spurious markers at one half or one third the specified marker interval.

Observe the markers and ensure that they are of equal amplitude throughout the range. Set the oscilloscope vertical gain to .5V/cm and adjust the MARKER SIZE control fully clockwise. The markers should be approximately 3V peak-to-peak in amplitude.

MARKER WIDTH

Turn on the 1 MHz markers. Adjust the center frequency and sweep width controls to calibrate the oscilloscope display for a 1 MHz sweep width. Adjust the center frequency to center a 1 MHz birdy on the display and note that the marker is approximately 400 kHz wide. Decrease the marker width by going to the PULL NARROW position of the marker size control. The marker width should be approximately 100 kHz.

MARKER ACCURACY

Marker accuracy may be verified by one of several methods. One method requires a signal generator and a frequency counter covering the desired marker frequency. First, adjust the sweep generator's center frequency to the markers frequency and the sweep width to approximately 2 MHz. Connect the output from the signal generator to the EXTERNAL MARKER IN jack, located on the rear panel, and carefully adjust the signal generator for a zero beat with the internally generated birdy marker. Next, connect the signal generator's output to the counter and read the signal generator frequency which is now identical to the internal markers frequency. Allowable error is .005% of the marker frequency.

Another method uses the counter only but requires the removal of the instrument and marker module covers. Probe the marker box with the input lead from the counter until sufficient signal is picked up to provide a counter reading. The highest crystal frequency used is approximately 50 MHz. Markers above this frequency use harmonics of the crystal frequency. Again, the allowable error is 0.005% of the crystal frequency.

Test equipment for the marker accuracy check is not listed in the recommended test equipment chart since the requirements vary with the method and the specific markers installed in the unit. Also, the inherent stability of the quartz crystal makes a marker accuracy check unnecessary in all but the most critical application.

5.3.13 Option "B" IF Tracking Feature Check

The performance of this option can be checked by the use of a sweep generator (Wavetek 1001A, or equivalent). Set the generator SWEEP TIME to LINE, the SWEEP WIDTH to 50 MHz, the center frequency to that of the "B" option (43.5 MHz U.S. standards or 36.15 MHz CCIR and other standards), and the RF OUTPUT to 1mV. Insert the signal at the IF INPUT jack. Pulse markers should appear at the required marker frequencies when pulse size control on the M5D and the front panel MARKER SIZE control are fully clockwise. Increase the test generator output to 100mV. No spurious markers should appear.

Disconnect the cable from the SCOPE VERTICAL OUTPUT jack and connect it to the rear panel PULSE MARKER OUTPUT jack. Positive or negative 35 volt pulses should be present, adjustable with the rear panel PULSE MARKER SIZE control and polarity switch.

5.3.14 Option "E" Automatic Frequency Feature Check

The M11E module is factory adjusted to work in conjunction with a typical tuner test set-up. To verify the operation of this feature, a properly aligned tuner should be used. The set-up, as shown in Figure 3-3, should be made. With the unit switched to its auto-frequency mode, the tuner should be tuned from one end of its range to the other. The tuner response should remain centered on the oscilloscope display.

5.3.15 Option "C" Automatic Level and Scope Indicator Check

The M8E module is also factory adjusted to work in conjunction with a typical tuner test set-up. To verify the operation of this feature, a properly aligned tuner should be used, and the set-up as shown in Figure 3-3 should be made. As shipped from the factory, the M8E is set for a gain of unity (i.e. no gain). With the controls set as in the above check, set the auto-frequency switch to manual and center the tuner response on the oscilloscope display with the frequency dial. Turn vernier level control to maximum clockwise, adjust the step attenuator to obtain the desired detector output as in paragraph 3.7. Reduce scope vertical gain to one volt full scale. Set polarity switch on the M8E for a positive pattern on the oscilloscope display. Using the two Gain controls on the M8E (X10 and variable) set the display for a one volt amplitude. The display should be similar to that shown in Figure 3-9. Switch the front panel Auto Level switch to the Auto position. There should be no change in the display amplitude. Up to 20 dB of attenuation can then be removed before the display amplitude will change.

To check the operation of the frequency indicator pulse, observe the pulse while turning the frequency dial from one end of its range to the other. As the dial is rotated, the indicator pulse should move from one end of the display to the other. As shown in Figure 3-10.

5.3.16 External Programming

External programming inputs are not normally checked during incoming inspection unless these special functions are to be used in a particular application. The external programming circuits are covered in section 3, paragraph 3-10 Programming. If it is necessary to check these functions at incoming inspection, reference can be made to that section of the manual for complete set-up instructions.

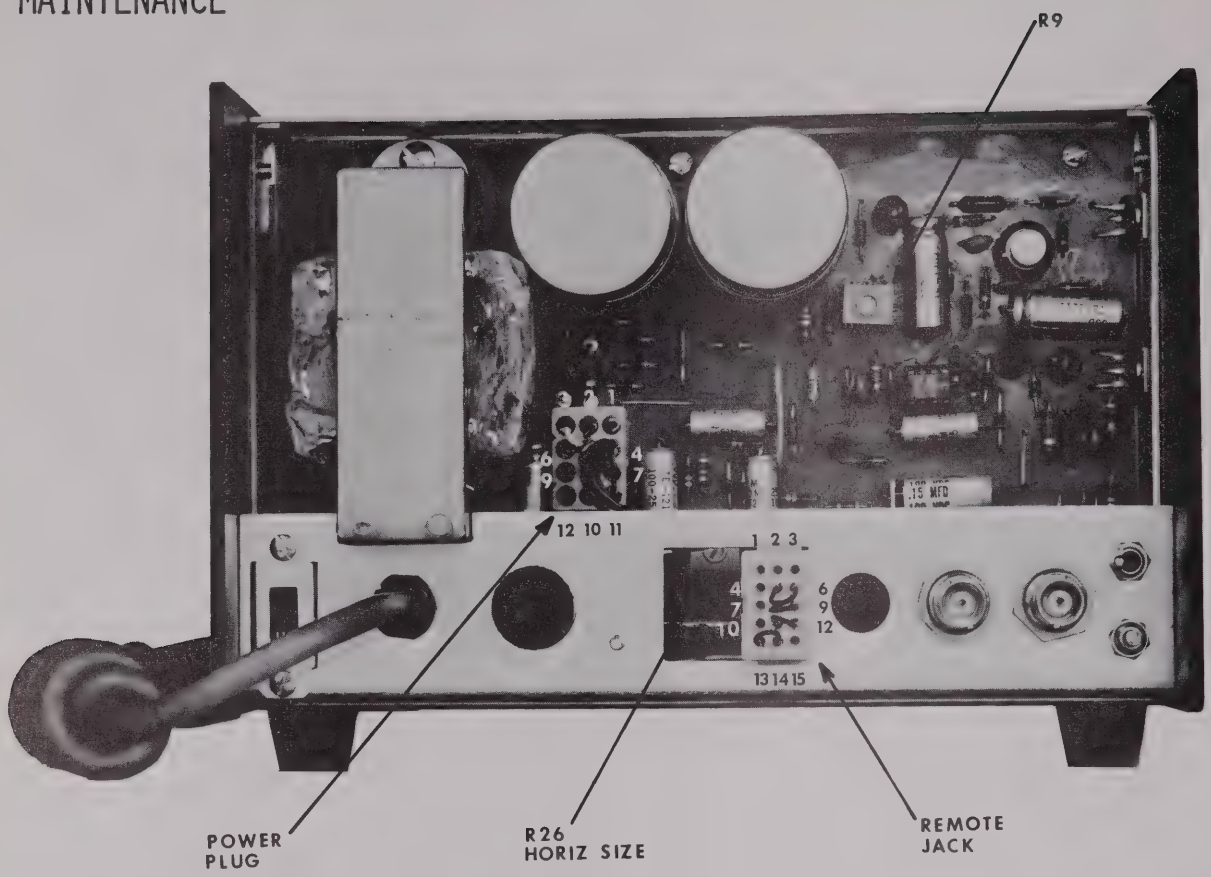


Figure 5-6. Power Supply

5.4 CALIBRATION PROCEDURE

Remove the top covers from both the instrument and the M2E-2 module (each cover is retained by a single screw located on the top). Turn the instrument "on" and allow a 15 minute warm-up period before calibrating.

In general, calibration must be performed in the sequence given.

5.4.1 +18 Volt Adjustment

Connect the digital voltmeter to the +18 volt supply, pin 6, on the power plug and adjust R9 to produce +18V ±10mV (See Figure 5-6).

5.4.2 -18 Volt Check

Connect the digital voltmeter to the -18 volt supply, pin 4, on the power plug. The -18 volt supply is designed to track the +18 volt supply and no independent adjustment is provided. The voltmeter should read -18V ±50mV.

5.4.3 Horiz Size Adjustment

Adjust the scope to operate in an X-Y mode with DC coupling on both the vertical and the horizontal inputs. Adjust the scopes horizontal sensitivity to exactly .2V/division (use the previously calibrated 18 volts supply to calibrate the horizontal sensitivity). With no horizontal input to the scope, position the dot on the scope to the exact center of the display.

Connect the HORIZ output from the sweep generator to the scopes horizontal input. Adjust R26 (See Figure 5-6) to produce a horizontal size on the scope display of -8 to +8 volts as shown in Figure 5-7. An offset either way of .2V is acceptable.

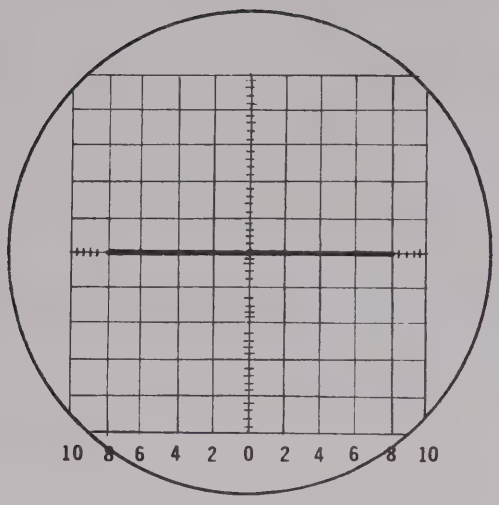


Figure 5-7. Horiz. Size

5.4.4 Module M2E-2 Size and Cent Adjustment

Leave HORIZ connected as in paragraph 5.4.3 and proceed by connecting the scope vertical input to T.P. #1 in the M2E-2 module (See Figure 5-10). Set the instruments front panel SWEEP WIDTH control to maximum. Set the scope vertical sensitivity to 5V/div. and adjust control A (size) and control B (center-int) to obtain a +14 to -14 volt signal centered about zero volts, See Figure 5-8.

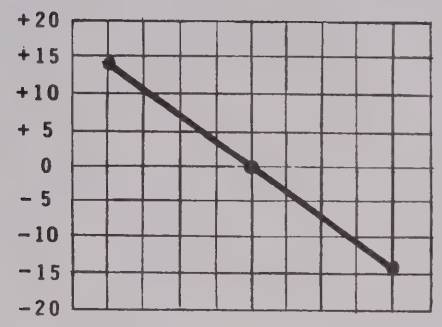


Figure 5-8. Test Point

5.4.5 Module M9S-1/M9JA Centering Adjustment

Connect the instrument as shown in Figure 5-9. Set the scope vertical sensitivity for .2V/div. and the scope horizontal sensitivity for a display pattern 10div. wide. Set the instruments ATTENUATION and LEVEL controls for maximum output (0 ATTENUATION, LEVEL fully clockwise, AUTO level switch down). Connect a D171/D151 detector to RF OUT and feed the output of the detector to the DEMOD IN terminal of the instrument. Set SWEEP WIDTH to maximum.

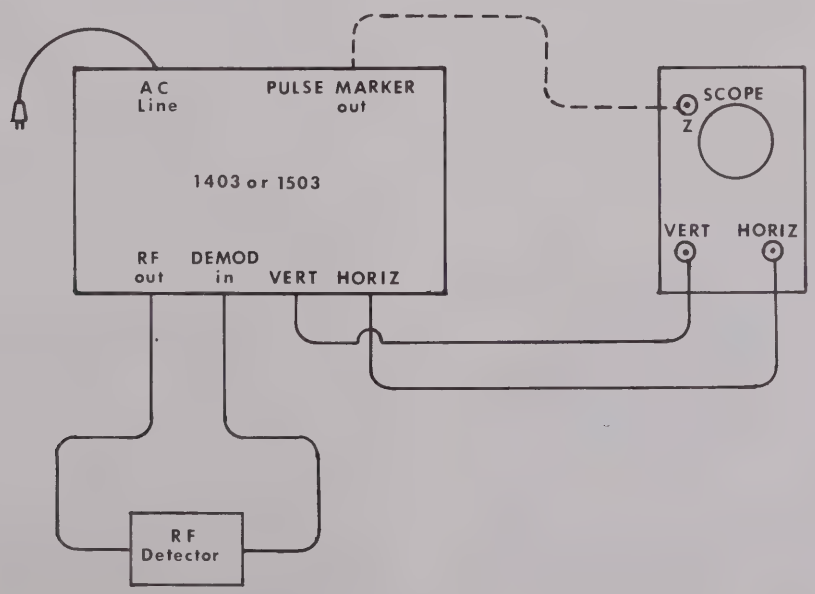


Figure 5-9. Test Set-Up

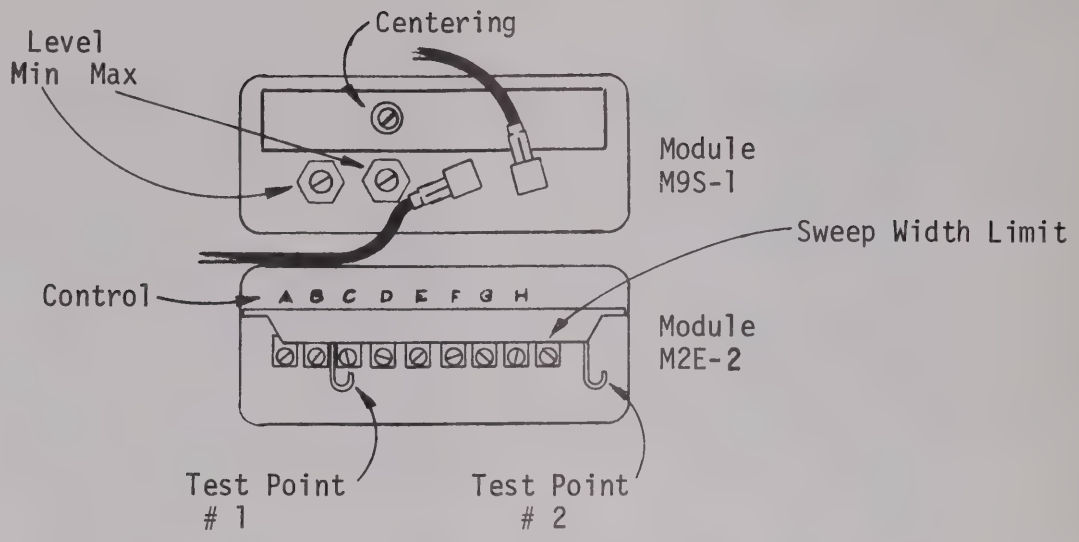


Figure 5-10. Adjustment Locations

Set the AUTO frequency switch to the down (manual) position and connect the digital voltmeter to the wiper arm of the FREQUENCY control pot. Set the FREQUENCY dial to obtain a reading of zero volts D.C. (this should correspond to a center frequency reading on the FREQUENCY dial).

Turn on the Single Frequency markers, (150 MHz/1403, 700 MHz/1503). Set the center frequency marker to the exact center of the display with the centering control on top of the M9 oscillator module. See Figure 5-11.

5.4.6 Module M2E-2 Sweep Width Adjustment

Turn on the Harmonic Markers (30 MHz/1403, 50 MHz/1503) and adjust the sweep width limit (See Figure 5-10) on the M2E-2 module to place the low frequency end band marker (1403/zero or 1503/450 MHz) 5% in from the extreme left scope graticule, See Figure 5-12.

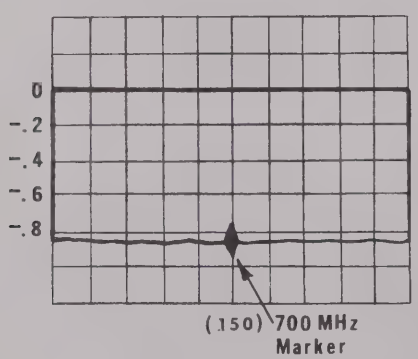


Figure 5-11. Centering Adjustment

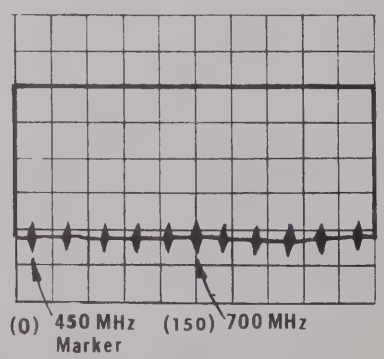


Figure 5-12. Sweep Width Adjustment

5.4.7 Module M2E-2 Linearity Reference

Keeping the center frequency marker in the center of the display, increase the scope horizontal sensitivity to place the low frequency marker on the extreme left scope graticule, See Figure 5-13.

Connect the scope vertical input to T.P. #2 of the M2E-2 module (See Figure 5-10) and adjust control C (Linearity Reference) to position the knee just to the right of the 9th scope graticule as shown in Figure 5-13.

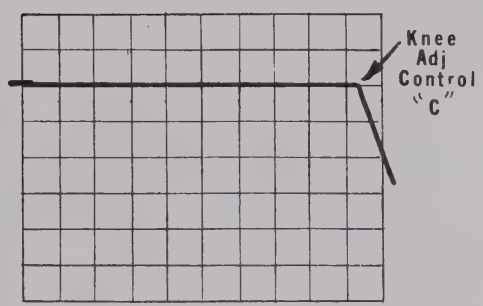


Figure 5-13. Linearity Adj Ref T.P. #2

5.4.8 Linearity Adjustment Module M2E-2

Leaving all the other settings and the connections as in section 5.4.7, reconnect the scope vertical to VERT of instrument. The M9 sweep oscillator is inherently linear from the low frequency end to the center frequency. Five adjustments are provided to improve the linearity from the center frequency to the high frequency end of the band.

50 MHz harmonic markers are used in setting the linearity on the 1503, 30 MHz markers are used for the 1403 linearity. Control "D", See Figure 5-10, is used to position the first marker to the right of the center frequency marker as shown in Figure 5-14. Control "E" adjusts the second marker to the right of center, "F" controls the 3rd marker, "G" the 4th, and "H" positions the final high frequency marker on the extreme right scope graticule. Adjustment must be made in the sequence given.

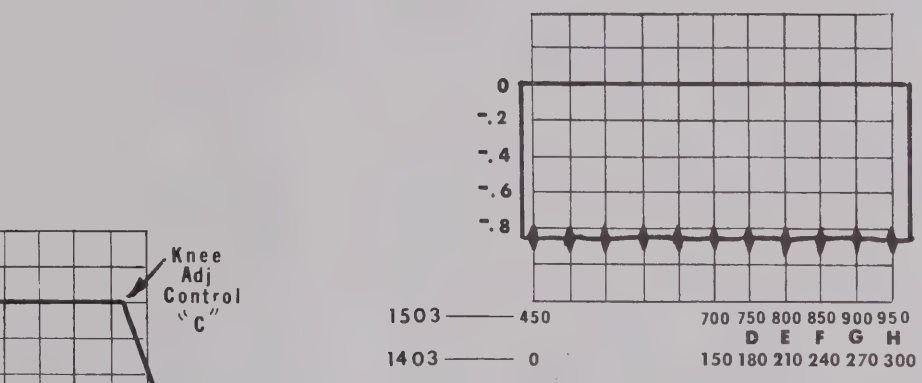


Figure 5-14 Linearity Adjustment

5.4.9 M9 Oscillator Module Min and Max Level Adjustment

With the instrument still set-up and producing a scope pattern similar to that of Figure 5-14, adjust the M9 LEVEL MAX control (See Figure 5-10) to produce a scope pattern amplitude of .8 volts when the front panel vernier attenuator is set at 0 dB *(this is equivalent to an output of .7V rms)*. Next, set the front panel LEVEL control fully counterclockwise and adjust the M9 LEVEL MIN control to produce a scope pattern of 40 millivolts. Some interaction exists between the LEVEL MIN and the MAX adjustments, so repeat the adjustments until both the 40 millivolt and the .8 volts range is obtained. The accuracy of the aobve procedure is dependent on the RF detector and is generally adequate. If more accuracy is required, a RF power meter can be substituted for the detector.

5.4.10 Module M5D Sweep Sample Adjustment

Set the scope horizontal sensitivity for a display of 10cm, and scope vertical sensitivity to 5mV/cm. Connect the detector to the "sweep sample" output connector on top of the M5D module. Adjust "Sweep Sample Adj" for a detected response of approximately 30mV (the sweep sample is not completely leveled but this will usually give a minimum of approximately 25mV detected). Reconnect the sweep sample output to the markers.

5.4.11 Option "A" Marker Size Adjustment (Module M6)

The marker size adjustment control is located on the bottom of the M6 Marker module and the shaft extends down through the instrument chassis. Adjustment necessitates removing the bottom cover of the instrument. This cover is released by removing the two screws in the rear feet. Correct adjustment is a slight saturation of all the birdy markers with no spurious markers present.

5.4.12 Option "B" IF Tracking Marker Adjustment (Module M7E)

The M7E module is factory set to provide the best possible operation over a wide range of input signals. In this mode, the adjustment pot on the top of the module is usually in a fully C.W. position. Input signals in excess of +10dBm came sometimes overdrive the module, causing the output markers to double trigger--in this case the top pot can be turned C.C.W. to decrease the input signal and can be readily returned to the fully C.W. position for a different input. In some cases an extremely weak signal (-55dBm or less) will fail to produce markers. Turning the AGC pot (located inside the module cover) C.C.W. can sometimes remedy this, but the original position of the pot should be marked for later resetting.

5.4.13 Option "E" Automatic Frequency Adjustment (Module M11E)

The M11E module is factory adjusted to work in conjunction with a "typical" tuner test set-up. Slight adjustments may sometimes be required for proper functioning with an individual customer's test set-up. The module is functioning properly if the tracking markers remain centered in the display as the tuner under test is varied throughout its range while the instrument is in the AUTO frequency mode.

If adjustment is needed, first adjust the gain control pot (End Band Adj) until the IF tracking markers remain stationary as the tuner is varied through its range, then center the markers with the "centering" control pot (Mid Band Adj).

The Low Freq. Cutoff, or Low Limit control is located inside the module cover. This control should Not be adjusted unless a mirror response is being captured (on 1403 only) or the capture fails to work on the low end of the sweep range. To adjust, set the tuner at the low end of the range and turn the control until capture is lost, then back the control off enough to recapture the response. (This control is to insure that the 1403 does not try to capture a mirror response located below zero frequency).

5.4.14 Option "C" Automatic Level and Scope Indicator Adjustment (Module M8E)

M8E module has three calibration adjustment controls accessable through the top of the module cover. The purpose of the "balance" adjustment is to set the baseline of the display to zero volts DC. The other two adjustments are used to calibrate the baseline frequency indicator marker to display the frequency setting directly in the scope.

To calibrate place the AUTO frequency switch in the down position and, using the FREQUENCY control dial, set the center frequency birdy marker in the exact center of the scope display, then set the frequency indicator marker to the center of the display using the "cent" pot on the M8E module. Next, set FREQUENCY dial to the low frequency setting and place the frequency indicator marker to the desired position on the left side of the scope display with the "range" pot on M8E. Marker should now traverse the baseline from left to right as the FREQUENCY dial is turned from the low frequency end to the high frequency end of the range.

5.5 TROUBLESHOOTING

Trouble shooting is generally a systematic procedure of "divide and conquer". A thorough understanding of the block diagrams and the circuit description located in section 4 of the manual will enable the trouble symptom to be associated with a particular module. This procedure can be summarized by referring to the module wiring diagram located in section 6 of this manual. Check the voltages and the waveforms at connector J2. Satisfactory waveforms here will eliminate the power supply P.C. board as the source of the trouble. Then check the voltages on the socket of the M9 oscillator module. If the voltages are wrong the trouble is probably in the M2E-2 Sweep Drive Module.

If the voltages at connector J2 are wrong, disconnecting it and checking P2 on the PS7 power supply may determine if a short circuit in the instrument head is producing the faulty waveform.

Once the trouble has been isolated to a module, or to the power supply, the modules or the power supply may either be replaced, or troubleshot and repaired with the aid of its schematic.

5.5.1 Troubleshooting Hints

The following is a list of several typical symptoms followed by the probable cause or a trouble shooting procedure.

FUSE BLOWS - Fuses sometimes fail for no apparent reason. A defect in the unregulated power supplies or the AC power sources would be a probable cause since a short circuit in a regulated supply, or its load, would cause current limiting which would not blow the fuse.

INTERMITTENT OPERATION OF ANY TYPE - Defective module pin sockets or loose RF cables.

NO RF OUTPUT - Defective attenuator or RF cables connecting to the input or output of the attenuator.

RF OUTPUT NOT FLAT - Most common cause is a defective external RF detector. Another is the moditor diode located in the M9 module. This point contact diode can be damaged if the RF output is momentarily connected to a B+ voltage. A good monitor diode will produce a negative detected voltage approximately twice the amplitude of the external detector. For example, at an RF output of .7rms an external RF detector will read approximately 0.8V. The internal monitor will read approximately -1.6V.

In replacing the monitor diode, unsolder the anode end only, and pull it out of its lead socket. Trim the leads of the replacement diode to the same dimensions, insert the cathode lead in the socket, and solder the resistor to the anode lead with the same lead dress as the original diode.

FREQUENCY UNSTABLE (JITTER) - Check all the modules for loose hold-down screws especially module M2E-2. Check both + and -18V power supplies. Operating the unit in a strong magnetic field, such as

setting on top of or adjacent to another instrument containing a large power transformer, can produce 60 Hz HUM modulation.

LOW RF OUTPUT, FREQUENCY AND VERNIER ATTENUATOR CONTROLS DO NOT FUNCTION- Check for the presence of remote plug P101.

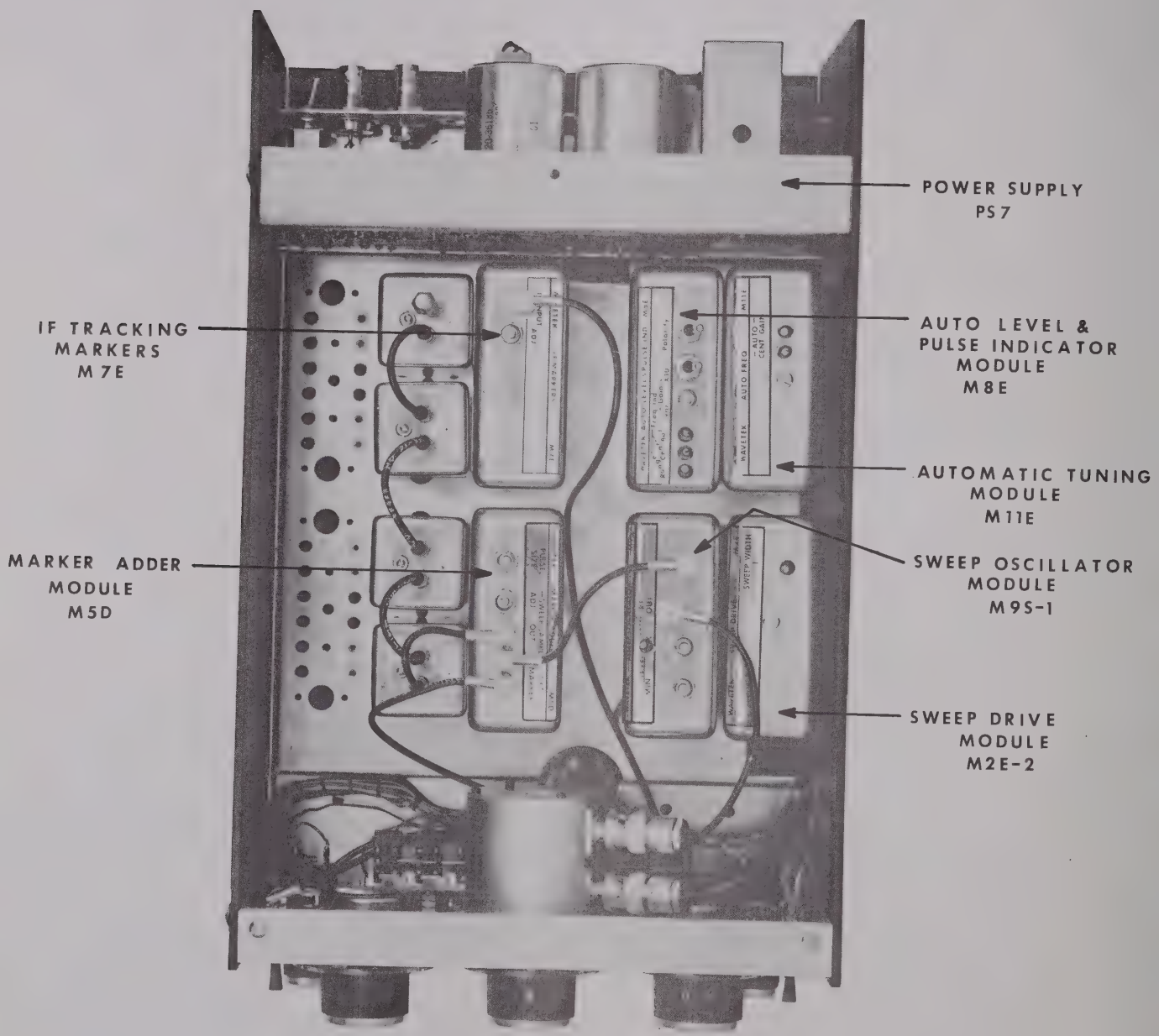


Figure 5-15. Model 1503 Top View

SECTION 6
SCHEMATICS AND PARTS LIST

6.1 INTRODUCTION — This section contains all schematics and a list of replaceable parts for the instrument. Parts lists are located on the reverse side of the associated schematics.

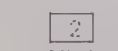
6.2 MANUFACTURER'S CODE — The following code is used on the parts list to identify the manufacturer.

A-B	Allen-Bradley	Milwaukee, Wisconsin
A-E	Arco-Elmenco	Great Neck, New York
AER	Aerovox	New Bedford, Massachusetts
ALC	Alco Electronic Products Inc.	Lawrence, Massachusetts
AMP	AMP, Inc.	Harrisburg, Pennsylvania
APL	Amphenol	Danbury, Conn.
APX	Amperex	Slatersville, R. I.
BEK	Beckman Instruments, Inc.	Fullerton, California
BEL	Belden	Chicago, Illinois
BOU	Bourns	Riverside, California
BUS	Bussman	St. Louis, Missouri
CAM	Cambion	Cambridge, Massachusetts
C-D	Cornell Dubilier	Newark, New Jersey
CGW	Corning Glass Works	Corning, New York
C-J	Cinch Jones	Elk Grove Village, Illinois
C-K	C & K Components	Watertown, Massachusetts
C-L	Centralab	Milwaukee, Wisconsin
CTS	Chicago Telephone Systems	Elkhart, Indiana
C-W	Continental Wire	Philadelphia, Pennsylvania
DIO	Diodes, Inc.	Chatsworth, California
DRA	Drake Mfg. Company	Harwood Heights, Illinois
ETP	Erie Technological Prod. Inc.	Erie, Pennsylvania
FCD	Fairchild	Mountain View, California
G-E	General Electric	Syracuse, New York
G-H	Grayhill	La Grange, Illinois
HHS	Herman H. Smith, Inc.	Brooklyn, New York
H-P	Hewlett-Packard	Palo Alto, California
HEY	Heyman Mfg. Company	Kenilworth, New Jersey
IRC	International Resistance Co.	Philadelphia, Pennsylvania
ITT	International Telephone & Telegraph	West Palm Beach, Florida
JEF	Jeffers	Dubois, Pennsylvania
KID	Kidco, Inc.	Medford, New Jersey
LIT	Littelfuse	Des Plaines, Illinois
MAL	Mallory	Indianapolis, Indiana
M-O	Marko-Oak	Anaheim, California
MOL	Molex	Downers Grove, Illinois
MOT	Motorola	Phoenix, Arizona
P-B	Potter & Brumfield	Princeton, Indiana
POM	Pomona Electronics Co., Inc.	Pomona, California
Q-C	Quality Components	St. Marys, Pennsylvania
RCA	Radio Corporation of America	Harrison, New Jersey

RMC	Radio Material Company	Chicago, Illinois
SCC	Stackpole Carbon Co.	St. Marys, Pennsylvania
SEL	Selectro	Mamaroneck, New York
SEM	Semtech	Newbury Park, California
SIG	Signetics Corporation	Sunnydale, California
S-I	Switchcraft, Inc.	Chicago, Illinois
SPR	Sprague	North Adams, Massachusetts
S-T	Sarkes Tarzian	Bloomington, Indiana
STR	Stettner & Co.	Nurnburg, Western Germany
SYL	Sylvania	Woburn, Massachusetts
THR	Thermalloy, Co.	Dallas, Texas
TRW	TRW Capacitor Division	Ogallala, Nebraska
W-E	Wells Electronics	South Bend, Indiana
W-I	Wavetek, Indiana, Inc.	Indianapolis, Indiana
WSD	Wavetek, San Diego	San Diego, California

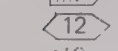
6.3 SCHEMATIC NOTES — The following notes and abbreviations pertain to all schematics. Additional notes pertaining to specific schematics are included on each schematic if required.

All resistor values are shown in "ohms" unless otherwise specified.
All capacitor values are shown in picofarads "pF" unless otherwise specified.
All inductor values are shown in microhenries "uH" unless otherwise specified.

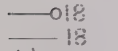


Denotes DC voltage reading in volts unless otherwise specified.

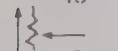
Denotes high impedance crystal detector reading in volts unless otherwise specified.



Denotes 50ohm crystal detector reading in volts unless otherwise specified.



Signal or voltage source



Connect to indicate signal or voltage source

Arrow indicates clockwise rotation of wiper

Coaxial jack

Coaxial plug

Coaxial cable

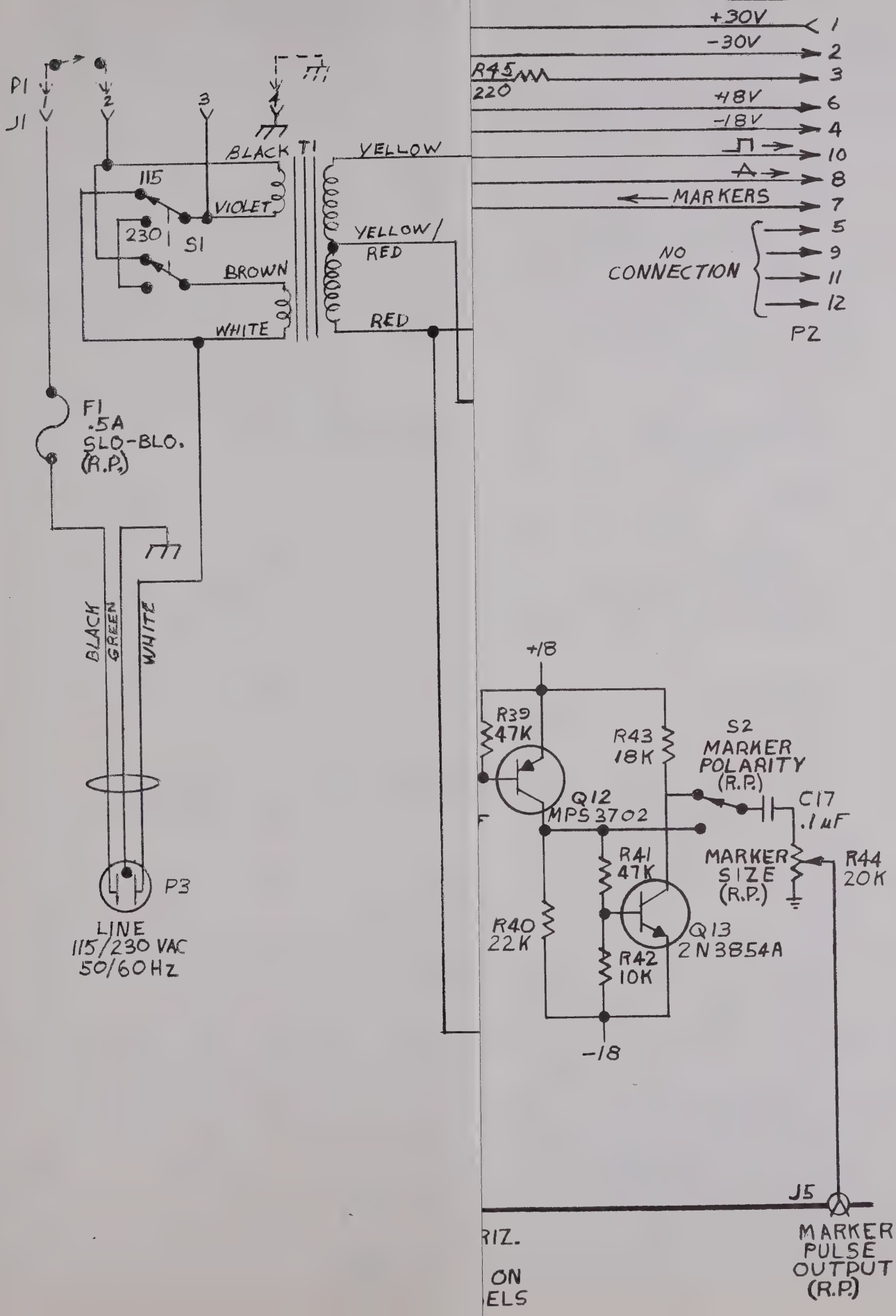
* Factory adjusted part

6.4 ABBREVIATION CODE

A	ampere	IF	intermediate frequency	Ω	ohm
ac	alternating current	kHz	kiloherz	p-p	peak to peak
C	capacitor	Kohm	kilohm	pF	picofarad
CR	diode	kv	kilovolt	Q	transistor
dB	decibel	kW	kilowatt	R	resistor
dBm	decibel referred to 1mW	L	inductor	RF	radio frequency
dc	direct current	MHz	megahertz	rms	root-mean-square
DS	device indicating, lamp	Mohm	megohm	R.P.	rear panel
F	farad	uF	microfarad	S	switch
F.P.	front panel	uA	microampere	T	transformer
H	henry	uH	microhenry	V	volt
Har	harmonic	mA	milliampere	VA	voltampere
Hz	hertz	mH	millihenry	W	watt
IC	integrated circuit	mV	millivolt	X	crystal
		mW	milliwatt		

67 POWER SUPPLY

REV. C



RMC	Radio Material Company	Chicago, Illinois
SCC	Stackpole Carbon Co.	St. Marys, Pennsylvania
SEL	Selectro	Mamaroneck, New York
SEM	Semtech	Newbury Park, California
SIG	Signetics Corporation	Sunnydale, California
S-I	Switchcraft, Inc.	Chicago, Illinois
SPR	Sprague	North Adams, Massachusetts
S-T	Sarkes Tarzian	Bloomington, Indiana
STR	Stettner & Co.	Nurnburg, Western Germany
SYL	Sylvania	Woburn, Massachusetts
THR	Thermalloy, Co.	Dallas, Texas
TRW	TRW Capacitor Division	Ogallala, Nebraska
W-E	Wells Electronics	South Bend, Indiana
W-I	Wavetek, Indiana, Inc.	Indianapolis, Indiana
WSD	Wavetek, San Diego	San Diego, California

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All capacitor values are shown in picofarads "pF" unless otherwise specified.
All inductor values are shown in microhenries "uH" unless otherwise specified.

Denotes DC voltage reading in volts unless otherwise specified.

Denotes high impedance crystal detector reading in volts unless otherwise specified.

Denotes 50ohm crystal detector reading in volts unless otherwise specified.

Signal or voltage source

Connect to indicate signal or voltage source

Arrow indicates clockwise rotation of wiper

Coaxial jack

Coaxial plug

Coaxial cable

* Factory adjusted part

6.4 ABBREVIATION CODE

A	ampere	IF	intermediate frequency	Ω	ohm
ac	alternating current	kHz	kiloherz	p-p	peak to peak
C	capacitor	Kohm	kilohm	pF	picofarad
CR	diode	kv	kilovolt	Q	transistor
dB	decibel	kW	kilowatt	R	resistor
dBm	decibel referred to 1mW	L	inductor	RF	radio frequency
dc	direct current	MHz	megahertz	rms	root-mean-square
DS	device indicating, lamp	Mohm	megohm	R.P.	rear panel
F	farad	uF	microfarad	S	switch
F.P.	front panel	uA	microampere	T	transformer
H	henry	uH	microhenry	V	volt
Har	harmonic	mA	milliampere	VA	voltampere
Hz	hertz	mH	millihenry	W	watt
IC	integrated circuit	mV	millivolt	X	crystal
		mW	milliwatt		

SCHEMATIC, PS7 POWER SUPPLY

REV. C

P1 J1 — 1, 2, 3, 4

T1: BLACK, YELLOW, YELLOW/RED, RED, VIOLET, BROWN, WHITE; 115 / 230 VAC; S1

F1 .5A SLO-BLO. (R.P.)

LINE 115/230 VAC 50/60Hz

BLACK, GREEN, WHITE

P3

CR1, CR2, CR3, CR4

C1 1250µF

C2 50µF

C3 100µF

C4 100

C5 .005µF

C6 100µF

C7 1250µF

C8 120

C9 100

C10 10µF

C11 100µF

C12 10µF

C13 .15µF

C14 10µF

R1 270

R2 1.8K

R3 5

R4 1K

R5 12.1K

R6 1.5K

R7 220

R8 3.9K +18V ADJ

R9 1K

R10 2.7K

R11 5

R12 470

R13 2.7K

R14 1K

R15 15K

R16 1K

R17 1K

R18 4.7K

R19 10K

R20 10K

R21 5

R22 10K

R23 47K

R24 100

R25 15K

R26 20K

R27 220K

R28 47K

R29 10K

R30 10K

R31 47

IC1 723C

IC2 741C

IC3A 72558P

IC3B 72558P

Q1 2N3644

Q2 2N5294

Q3 2N5294

Q4 2N3644

Q5 2N3644

Q6 2N3854A

Q7 2N5306

CR5, CR6, CR7, CR8, CR9, CR10, CR11, CR12, CR13, CR14, CR15, CR16, CR17

+18, -18

TRIANGLE SIZE

24 VAC R45 220

+30V — 1

-30V — 2

+18 — 3

+8V — 6

-18V — 4

10

8

MARKERS — 7

NO CONNECTION — 5, 9, 11, 12

P2

R38 10K, R39 47K, R40 22K, R41 47K, R42 10K, R43 18K, R44 20K

C16 .05µF, C17 .1µF

Q12 MPS3702, Q13 2N3854A

S2 MARKER POLARITY (R.P.)

MARKER SIZE (R.P.)

J4 SCOPE HORIZ. (R.P.) NOT USED ON SOME MODELS

J5 MARKER PULSE OUTPUT (R.P.)

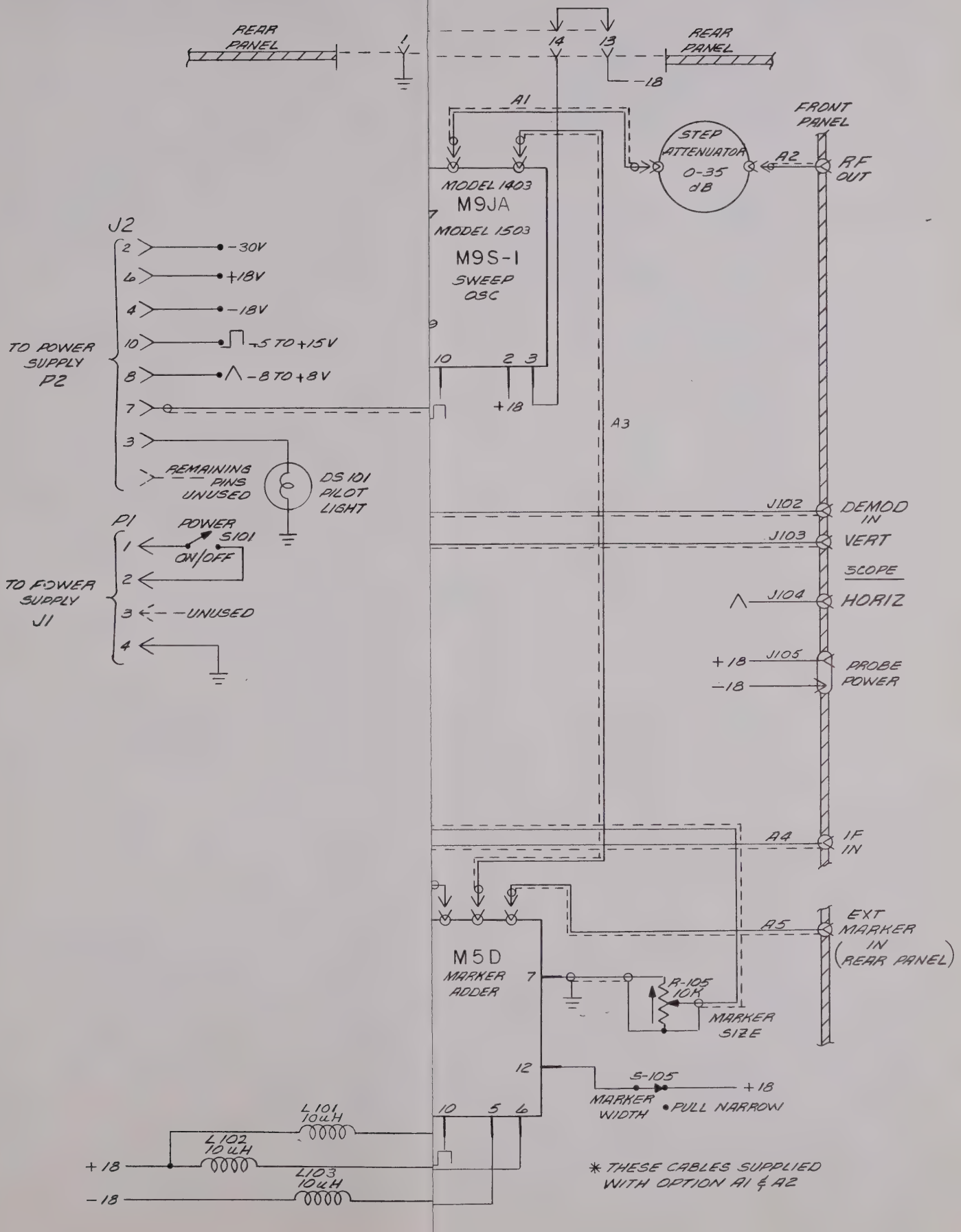
PARTS LIST PS7 POWER SUPPLY REV C

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
43	Fixed, comp., 18k ohm ±10% ¼W	RC104-318	A-B	CB1831	1
45	Fixed, comp., 220 ohm ±10% ½W	RC106-122	A-B	EB2211	1
"T"	TRANSFORMERS				
1	115/230 X48 Vac, center tapped	TT000-022	W-I	TT000-022	1
"Q"	TRANSISTORS				
1,4,5	PNP, Silicon	QA036-440	FCD	2N3644	3
2,3	NPN, Silicon	QA052-940	RCA	2N5294	2
6,13	NPN, Silicon	QA038-541	G-E	2N3854A	2
7	NPN, Silicon, Darlington	QA053-060	G-E	2N5306	1
8 to 11	Not assigned	---	---	---	--
12	PNP, Silicon	QB000-009	MOT	MPS3702	1
	PARTS MOUNTED ON CHASSIS, AND MISCELLANEOUS PARTS				
"C"	CAPACITORS				
17	Ceramic disc., .1uF ±20% 100V	CD103-410	SPR	TG-P10	1
"J"	CONNECTORS (JACKS)				
1	4-pin receptacle	MC000-034	MOL	1625-4R-1	1
----	contact, female, for above	MC000-018	MOL	1855	4
4 *, 5	BNC, receptacle	JB109-111	APL	UG911A/U	1
"P"	CONNECTORS (PLUG)				
3	AC plug/cord assembly (USA-Canada)	WL002-088	BEL	17237	1
	AC plug/cord assembly (Western Europe)	WL007-088	BEL		
"F"	FUSES				
1	.5 amp., slo-blo (used with 115Vac line)	MF000-007	BUS	MDV½	1
	.25 amp., slo-blo (used with 230Vac line)	MF000-006	BUS	MDV½	-
	Fuse holder, for above	MF000-001	BUS	HMM	1
"R"	RESISTORS				
44	Variable, carbon 20k ohm ±20% ¼W	RP124-320	A-B	WA2G032	1
"S"	SWITCHES				
1	DPDT, slide, power change	SS000-003	S-I	46256LFE	1
2	SPDT, toggle, on, non, off, sub-miniature	ST000-003	ALC	MST105D	1
	MISCELLANEOUS				
	Bushing, strain relief	HB104-000	HET	SR5P1	1
	10 lead, TO-5 pad	HQ103-000	THR	7717-21DAP	1
	Insulated shoulder washer	HW110-400	RCA	DF137A	2
	Transistor mtg. insulator, mica	HQ101-003	W-I	HQ101-003	2
	8 lead, in line I.C. socket	MC000-040	T-I	IC8ST7520	2

*Not used on all models.

MODULE WIRING DIAGRAM
1403 & 1503 HEAD

REV. A



PARTS LIST PS7 POWER SUPPLY REV C

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
----------	PARTS MOUNTED ON PRINTED CIRCUIT BOARD				
"C ____"	CAPACITORS				
1,7	Electrolytic, 1250uF 50V	CE114-212	SPR	PCL-1339	2
2	Electrolytic, 50uF 50V	CE107-050	SPR	TE1307	1
3,6,11	Electrolytic, 100uF 25V	CE105-110	SPR	TE1211	3
4,9	Ceramic disc, 100pF ±20% 1kV	CD102-110	SPR	5GA-T10	2
5	Ceramic disc, .005uF ±20% 100V	CD103-250	SPR	TG-D50	1
8	Ceramic disc, 120pF ±20% 1kV	CD102-112	SPR	5GA-T12	1
10,12,14	Electrolytic, 10uF 25V	CE105-010	SPR	TE1204	3
13	Mylar Paper, .15uF ±10% 100V	CP103-415	CDE	WMF1P15	1
15	Not assigned	---	---	---	--
16	Ceramic disc, .05uF ±20% 100V	CD103-350	SPR	TG-S50	1
"P ____"	CONNECTORS (PLUGS)				
2	12-pin printed circuit	MC000-031	MOL	03-04-4121	1
"CR ____"	DIODES				
1 to 17	Silicon, junction, 100piV 3/4A	DR000-001	ITR	1N4002	17
"IC ____"	INTEGRATED CIRCUITS				
1	Voltage regulator, 10 pin TO-5	IC000-001	FCD	U5R7723393	1
2	Operational amplifier, 8 pin in line	IC000-002	SIG	N5741V	1
3	Dual Operational amplifier, 8 pin in line	IC000-005	T-I	72558P	1
"R ____"	RESISTORS				
1	Fixed, comp., 270 ohm ±10% ¼W	RC104-127	A-B	CB2711	1
2	Fixed, comp., 1.8k ohm ±10% ¼W	RC104-218	A-B	CB1821	1
3,11,21	Fixed, deposited carb., 5 ohm ±1% ¼W	RD01R-050	KID	K-C¼	3
4,14	Fixed, metal film., 1k ohm ±1%	RF212-100	COR	RN55D/C4	2
5	Fixed, metal film., 12.1k ohm ±1%	RF213-121	COR	RN55D/C4	1
6	Fixed, comp., 1.5k ohm ±10% ¼W	RC104-215	A-B	CB1521	1
7	Fixed, comp., 220 ohm ±10% ¼W	RC104-122	A-B	CB2211	1
8	Fixed, comp., 3.9k ohm ±5% ¼W	RC103-239	A-B	CB3925	1
9	Variable, cermet, 1k ohm ±20%	RP131-210	CTS	360T102B	1
10	Fixed, comp., 2.7k ohm ±5% ¼W	RC103-227	A-B	CB2725	1
12	Fixed, comp., 470 ohm ±10% ¼W	RC104-147	A-B	CB4711	1
13	Fixed, comp., 2.7k ohm ±10% ½W	RC106-227	A-B	EB2721	1
15	Fixed, metal film, 15k ohm ±1%	RF213-150	COR	RN55D/C4	1
16,17	Fixed, comp., 1k ohm ±10% ¼W	RC104-210	A-B	CB1021	2
18	Fixed, comp., 4.7k ohm ±10% ¼W	RC104-247	A-B	CB4721	1
19,20	Metal film, matched set, 10k ohm ±.1%	RX000-003	W-I	RX000-003	1
22,29,30,38 42	Fixed, comp., 10k ohm ±10% ¼W	RC104-310	A-B	CB1031	5
23,28,39,41	Fixed, comp., 47k ohm ±10% ¼W	RC104-347	A-B	CB4731	4
24	Fixed, comp., 100 ohm ±10% ¼W	RC104-110	A-B	CB1011	1
25	Fixed, comp., 15k ohm ±10% ¼W	RC104-315	A-B	CB1531	1
26,44	Variable, cermet 20k ohm ±20%	RP131-320	CTS	360T203B	2
27	Fixed, comp., 220k ohm ±10% ¼W	RC104-122	A-B	CB2241	1
31	Fixed, comp., 47 ohm ±10% ¼W	RC104-047	A-B	CB4701	1
32 to 37	Not assigned	---	---	---	--
40	Fixed, comp., 22k ohm ±10% ¼W	RC104-322	A-B	CB2231	1
43	Fixed, comp., 18k ohm ±10% ¼W	RC104-318	A-B	CB1831	1
45	Fixed, comp., 220 ohm ±10% ½W	RC106-122	A-B	EB2211	1
"T ____"	TRANSFORMERS				
1	115/230 X48 Vac, center tapped	TT000-022	W-I	TT000-022	1
"Q ____"	TRANSISTORS				
1,4,5	PNP, Silicon	QA036-440	FCD	2N3644	3
2,3	NPN, Silicon	QA052-940	RCA	2N5294	2
6,13	NPN, Silicon	QA038-541	G-E	2N3854A	2
7	NPN, Silicon, Darlington	QA053-060	G-E	2N5306	1
8 to 11	Not assigned	---	---	---	--
12	PNP, Silicon	QB000-009	MOT	MPS3702	1
----------	PARTS MOUNTED ON CHASSIS, AND MISCELLANEOUS PARTS				
"C ____"	CAPACITORS				
17	Ceramic disc., .1uF ±20% 100V	CD103-410	SPR	TG-P10	1
"J ____"	CONNECTORS (JACKS)				
1	4-pin receptacle	MC000-034	MOL	1625-4R-1	1
----	contact, female, for above	MC000-018	MOL	1855	4
4 *, 5	BNC, receptacle	JB109-111	APL	UG911A/U	1
"P ____"	CONNECTORS (PLUG)				
3	AC plug/cord assembly (USA-Canada)	WL002-088	BEL	17237	1
	AC plug/cord assembly (Western Europe)	WL007-088	BEL		
"F ____"	FUSES				
1	.5 amp., slo-blo (used with 115Vac line)	MF000-007	BUS	MDV½	1
	.25 amp., slo-blo (used with 230Vac line)	MF000-006	BUS	MDV½	-
	Fuse holder, for above	MF000-001	BUS	HMM	1
"R ____"	RESISTORS				
44	Variable, carbon 20k ohm ±20% ¼W	RP124-320	A-B	WA2G032	1
"S ____"	SWITCHES				
1	DPDT, slide, power change	SS000-003	S-I	46256LFE	1
2	SPDT, toggle, on, non, off, sub-miniature	ST000-003	ALC	MST105D	1
	MISCELLANEOUS				
	Bushing, strain relief	HB104-000	HET	SR5P1	1
	10 lead, TO-5 pad	HQ103-000	THR	7717-21DAP	1
	Insulated shoulder washer	HW110-400	RCA	DF137A	2
	Transistor mtg. insulator, mica	HQ101-003	W-I	HQ101-003	2
	8 lead, in line I.C. socket	MC000-040	T-I	IC8ST7520	2

*Not used on all models.

PARTS LIST PS7 POWER SUPPLY REV C

MODULE WIRING DIAGRAM
1403 & 1503 HEAD

REV. A

EXT. SWEEP WIDTH
10K

+18
EXT. FREQ
10K
10K
10K
-18

-18
EXT. LEVEL
10K

REAR PANEL
1 2 3 15 10 11 12 8 9 5 6 14 13
REMOTE PLUG P101
REMOTE JACK J101
+18 -18
REAR PANEL
-18

PULL NARROW S102
R101 91K
R102 10K
SWEEP WIDTH

+18
FREQ
R103 10K
-18

-18
LEVEL
R104 10K
S104
AUTO

S103
AUTO
AUTO

M2E-2
SWEEP DRIVE
5 12 1 7 6 10 9 3 2
-18 +18

A1
STEP ATTENUATOR 0-35 dB
A2
FRONT PANEL
RF OUT

MODEL 1403
M9JA
MODEL 1503
M9S-1
SWEEP OSC
7 9 10 2 3
+18

A3

J2
2 -30V
6 +18V
4 -18V
10 -5 TO +15V
8 ⋀ -8 TO +8V
7
3
TO POWER SUPPLY P2
REMAINING PINS UNUSED
DS 101 PILOT LIGHT

P1
1 POWER S101 ON/OFF
2
3 — UNUSED
4
TO POWER SUPPLY J1

J102 DEMOD IN
J103 VERT
SCOPE
J104 HORIZ
+18 J105 PROBE POWER
-18

M11E
AUTOMATIC FREQUENCY (OPTION E)
1 12 6 8
CAPTURE
10 4 3 2
⋀ -18 +18

M8E
AUTOMATIC LEVEL & SCOPE INDICATORS
8 9 6 11 7 (OPTION C)
10 4 12 3 2
-30 -18 +18

A4 IF IN

R106
h g f e d c b a
4 3
M6 RF MARKERS (OPTION A1 & A2)

A5 EXT MARKER IN (REAR PANEL)

A6

M7E
IF TRACKING MARKERS (OPTION B)
6 8 2 3

M5D
MARKER ADDER
7 1 2 3 4 8 12 10 5 6

R-105 10K
MARKER SIZE

S-105
MARKER WIDTH
+18
PULL NARROW

L101 10uH
L102 10uH
L103 10uH
+18
-18

h g f e d c b a
S-106

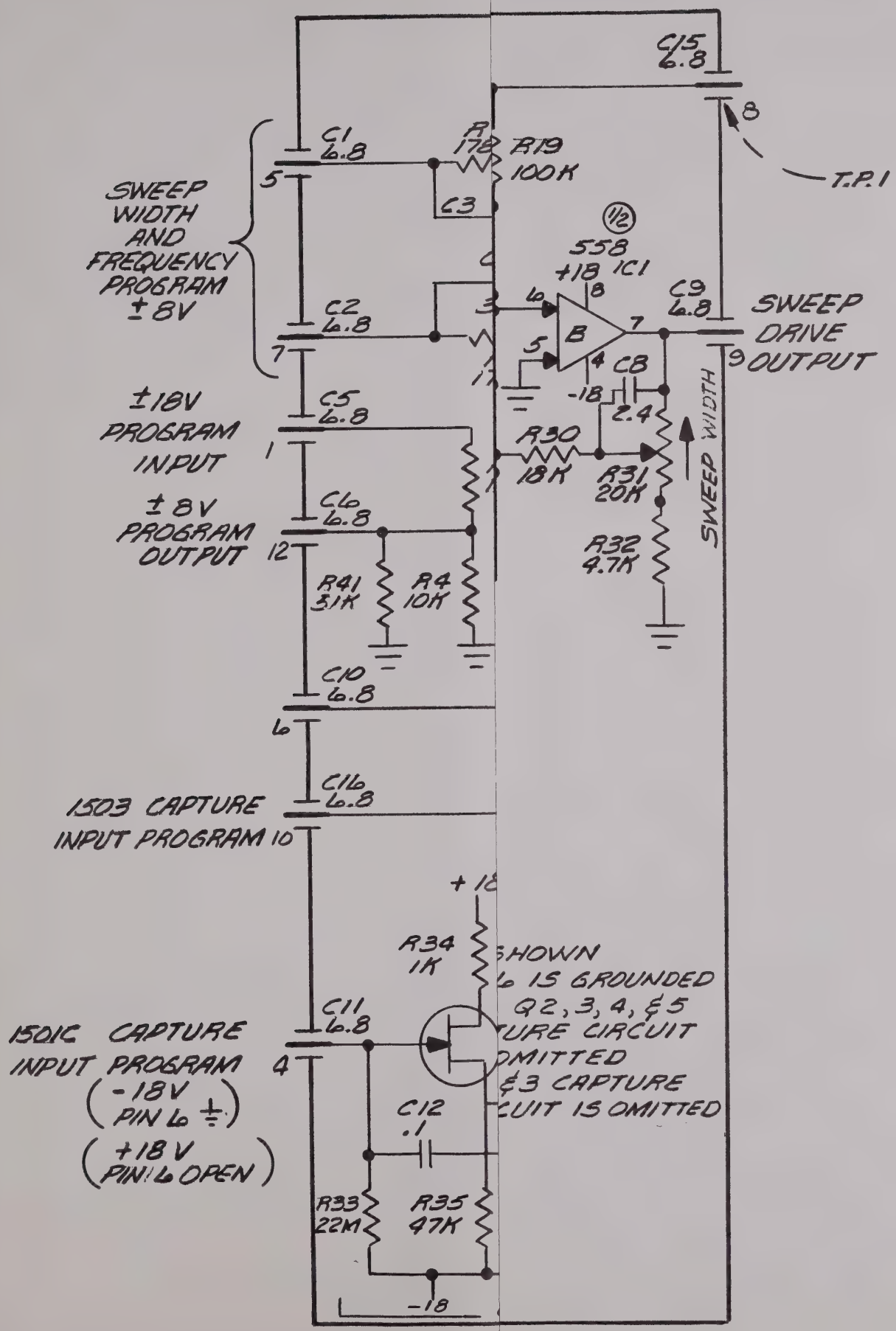
* THESE CABLES SUPPLIED WITH OPTION A1 & A2

PARTS LIST MODEL 1403 & 1503 HEAD MODULE REV A

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"DS "	LAMPS				
101	Indicator, incandescent	MB000-003	M-O	99-33080	1
"R "	RESISTORS				
101	Fixed, comp., 91k ohm ±5% ¼W	RC103-391	A-B	CB9135	1
102,105	Variable, carbon 10k ohm	RP134-310	W-I	RP134-310	2
103,104	Variable, carbon 10k ohm	RP118-310	A-B	JAIN056	2
"S "	SWITCHES				
101	SPST	ST000-007	W-I	ST000-007	1
102,105	SPST Push on, part of R102 or R105	-----	--	-----	--
103	DPDT	ST003-006	C-K	7201P	1
104	SPDT	ST001-006	C-K	7101P	1
106	Push-button switch assembly	SZ001-011	C-L	PB15,8sta	1
See Figure 3-1	MISCELLANEOUS MECHANICAL				
1	Knob, frequency 1403	KK170-226	W-I	KK170-226	1
1	Knob, frequency 1503	KK170-210	W-I	KK170-210	1
2	Knob, attenuation	KK170-168	W-I	KK170-168	1
3	Knob, Level	KK170-211	W-I	KK170-211	1
4,6	Knob, 23/32 dia.	KK000-016	BUK	PS-70D-2	2
5	Push button, black plain	SZ000-007	C-L	J52304B	--

EP DRIVE SCHEMATIC
ULE M2E (M2E-1, M2E-2)

REV. B



PARTS LIST MODEL 1403 & 1503 HEAD

REV A

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
	STANDARD MODULES				
M2E-2	Sweep Drive Module	M2E-2	W-I	M2E-1	1
M5D	Marker Adder Module	M5D	W-I	M5D	1
M9JA	Oscillator Module Model 1403	M9JA	W-I	M9JA	1
M9S-1	Oscillator Module Model 1503	M9S-1	W-I	M9S-1	1
	OPTIONS				
A1	Single frequency marker, 1 to 1000 MHz (Specify Frequency)	M6S	W-I	M6S	
A2	Harmonic markers 1, 10 and 50 MHz (Specify Frequency)	M6H	W-I	M6H	
B	IF Tracking Markers	M7E	W-I	M7E	
C	Automatic Level & Scope Indicators	M8E	W-I	M8E	
E	Automatic Frequency	M11E	W-I	M11E	
"A ___"	ASSEMBLIES				
1	RF Cable, 75 ohm	WX1403-A1	W-I	WX1403-A1	1
1	RF Cable, 50 ohm	WX1503-A1	W-I	WX1503-A1	1
2	RF Cable, 75 ohm	WX1403-A2	W-I	WX1403-A2	1
2	RF Cable, 50 ohm	WX1503-A2	W-I	WX1503-A2	1
3	RF Cable, 50 ohm	WX1503-A3	W-I	WX1503-A3	1
4	RF Cable, 50 ohm	WX1503-A4	W-I	WX1503-A4	1
5	RF Cable, 50 ohm	WX1503-A5	W-I	WX1503-A5	1
6	RF Cable, 50 ohm	WX1503-A6	W-I	WX1503-A6	1
----	S101 assembly with associated parts	B500-247	W-I	B500-247	1
----	P101 assembly with associated parts	B500-233	W-I	B500-233	1
----	Step Attenuator 75 ohm	7535-1	W-I	7535-1	1
----	Step Attenuator 50 ohm	5035-1	W-I	5035-1	1
"J ___"	CONNECTORS (JACKS)				
2	12-pin receptacle	MC000-030	MOL	1360-R1	1
	Contact, female, for above	MC000-032	MOL	1433	7
	Contact, male, for above	MC000-033	MOL	1434	1
101	15-pin receptacle	MC000-016	MOL	1625-15R	1
	Contact, female, for above	MC000-018	MOL	1855	13
102,103	BNC Cable jack receptacle	MB000-003	W-I	JB000-003	2
104	BNC, receptacle	JB109-111	APL	UG911A/U	1
105	BNC, Twinax receptacle	JB000-015	APL	31-223	1
----	Pin Socket, Teflon	MC000-002	W-I	MC000-002	--
"P ___"	CONNECTORS (PLUGS)				
1	4-pin	MC000-035	MOL	1625-4P1	1
	Contact, male, for above	MC000-041	MOL	1560	3
101	15-pin	MC000-017	MOL	1625-15P	1
	Contact, male, for above	MC000-019	MOL	1854	8
"L ___"	INDUCTORS				
101,102,103	Fixed, 10uH	LA001-010	JEF	15	3

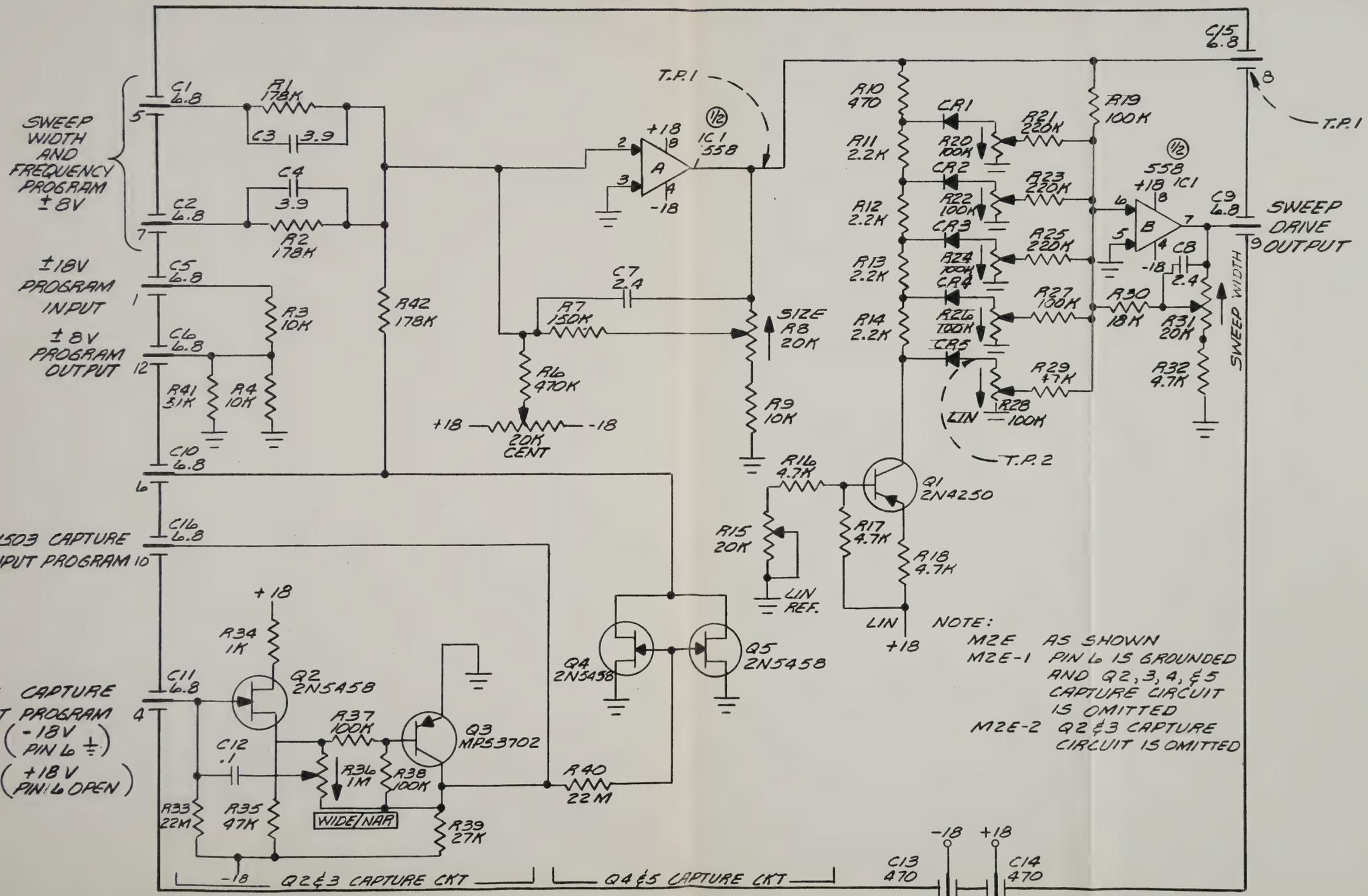
PARTS LIST MODEL 1403 & 1503 HEAD MODULE

REV A

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"DS ___"	LAMPS				
101	Indicator, incandescent	MB000-003	M-O	99-33080	1
"R ___"	RESISTORS				
101	Fixed, comp., 91k ohm ±5% ¼W	RC103-391	A-B	CB9135	1
102,105	Variable, carbon 10k ohm	RP134-310	W-I	RP134-310	2
103,104	Variable, carbon 10k ohm	RP118-310	A-B	JAIN056	2
"S ___"	SWITCHES				
101	SPST	ST000-007	W-I	ST000-007	1
102,105	SPST Push on, part of R102 or R105	-----	--	-----	--
103	DPDT	ST003-006	C-K	7201P	1
104	SPDT	ST001-006	C-K	7101P	1
106	Push-button switch assembly	SZ001-011	C-L	PB15,8sta	1
See Figure 3-1	MISCELLANEOUS MECHANICAL				
1	Knob, frequency 1403	KK170-226	W-I	KK170-226	1
1	Knob, frequency 1503	KK170-210	W-I	KK170-210	1
2	Knob, attenuation	KK170-168	W-I	KK170-168	1
3	Knob, Level	KK170-211	W-I	KK170-211	1
4,6	Knob, 23/32 dia.	KK000-016	BUK	PS-70D-2	2
5	Push button, black plain	SZ000-007	C-L	J52304B	--

SWEEP DRIVE SCHEMATIC
MODULE M2E (M2E-1, M2E-2)

REV. B

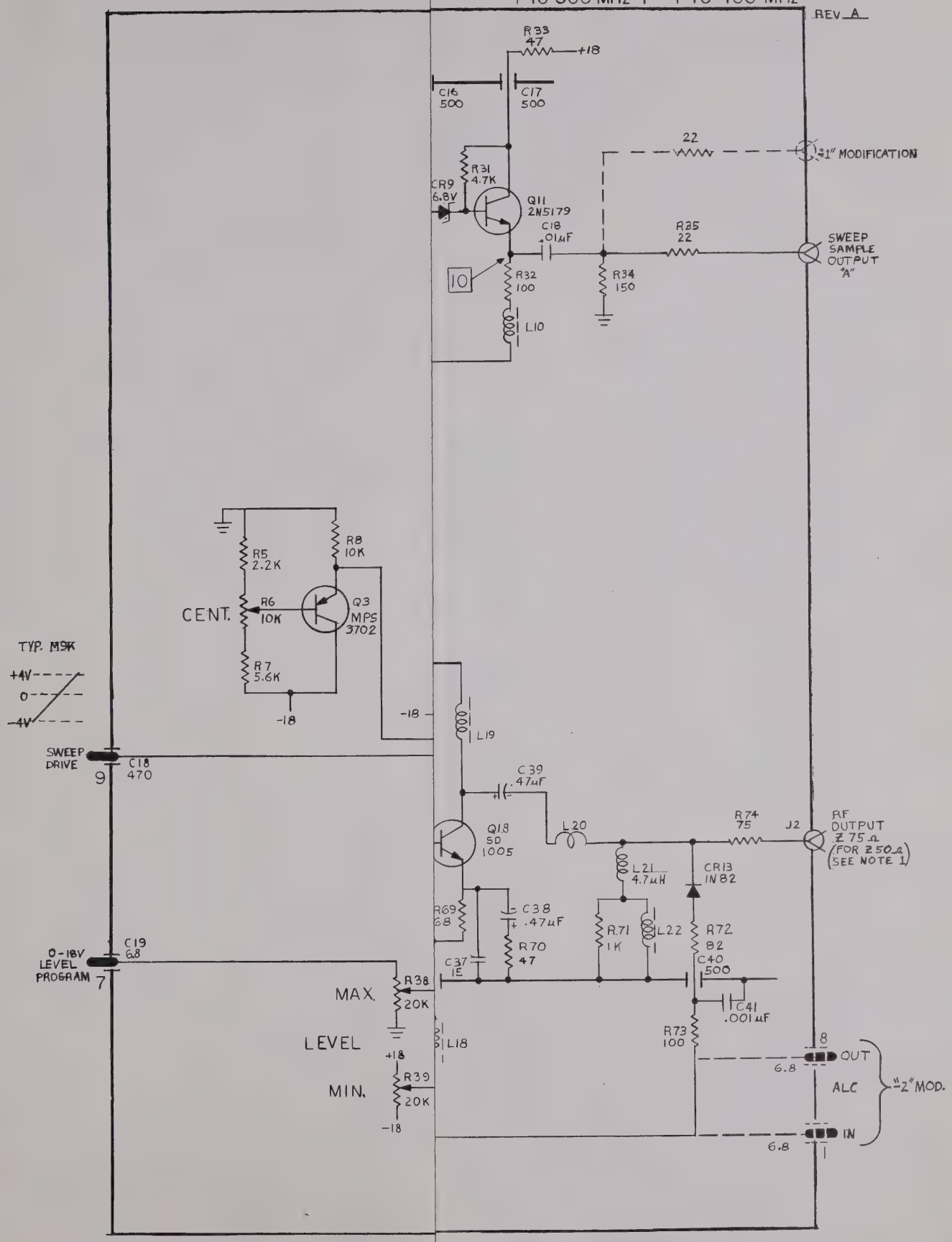


NOTE1: FOR Z OF 50Ω, 50 AND THE A FROM THE MOD

HETERODYNE SWEEP OSCILLATOR SCHEMATIC

MODULE M9JA 1 TO 300 MHz | MODULE M9KA 1 TO 400 MHz

REV A



PARTS LIST

MODULE M2E REV C

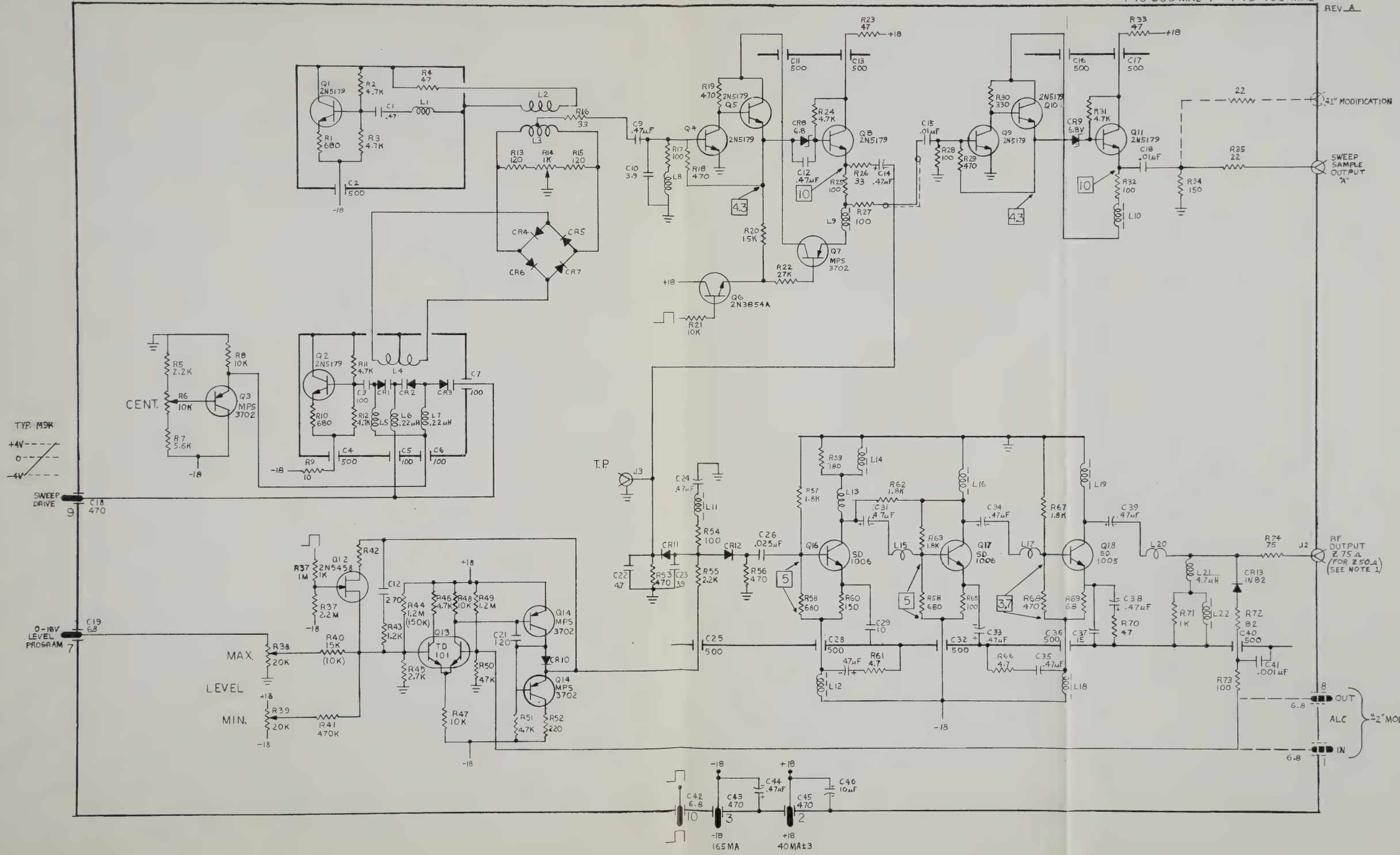
REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"C "	CAPACITORS				
1,2,5,6,9, 10,11,15 16,17	Ceramic feedthru 6.8pF ±10% 500V	CF102-R68	A-B	FA5C	8
3,4	Composition, 3.9pF ±10% 500V	CG101-239	Q-C	QC3.9	2
7,8	Composition, 2.4pF ±10% 500V	CG101-224	Q-C	QC2.4	2
12	Ceramic disc., .1uF ±20% 100V	CD103-310	SPR	TG-P10	1
13,14	Ceramic feedthru 470pF ±20% 500V	CF101-147	A-B	FA5C	2
"CR "	DIODES				
1 to 5	Silicon, junction, 100 p.i.V. 750mA	DR000-001	ITR	1N4002	5
"IC "	INTEGRATED CIRCUITS				
1	Dual operational amplifier 8 pin in line	IC000-005	T-I	72558P	1
"R "	RESISTORS				
1,2,42	Metal film, 178k ohm, matched set .1%	RX000-002	W-I	RX000-002	1
3,4	Metal film 10k ohm ±1%	RF213-100	COR	RN55D	2
5,8,15,31	Variable, cermet, 20k ohm ±10% 3/4W	RP130-320	BEK	89PR20K	4
6	Fixed, comp., 470k ohm ±10% ¼W	RC104-447	A-B	CB4741	1
7	Fixed, comp., 150k ohm ±10% ¼W	RC104-415	A-B	CB1541	1
9	Fixed, comp., 10k ohm ±10% ¼W	RC104-310	A-B	CB1031	1
10	Fixed, comp., 470 ohm ±10% ¼W	RC104-147	A-B	CB4711	1
11,12,13,14	Fixed, comp., 2.2k ohm ±10% ¼W	RC104-222	A-B	CB2221	4
16,17,18,32	Fixed, comp., 4.7k ohm ±10% ¼W	RC104-247	A-B	CB4721	4
19,27,37,38	Fixed, comp., 100k ohm ±10% ¼W	RC104-410	A-B	CB1041	4
20,22,24,26 28	Variable, cermet 100k ohm ±10% 3/4W	RP130-410	BEK	89PR100K	5
21,23,25	Fixed, comp., 220k ohm ±10% ¼W	RC104-422	A-B	CB2241	3
29,35	Fixed, comp., 47k ohm ±10% ¼W	RC104-347	A-B	CB4731	2
30	Fixed, comp., 18k ohm ±10% ¼W	RC104-318	A-B	CB1831	1
33,40	Fixed, comp., 22M ohm ±10% ¼W	RC104-622	A-B	CB2261	2
34	Fixed, comp., 1k ohm ±10% ¼W	RC104-210	A-B	CB1021	1
36	Variable, cermet 1M ohm ±10% 3/4W	RP130-510	BEK	89PR1meg	1
39	Fixed, comp., 27k ohm ±10% ¼W	RC104-327	A-B	CB2731	1
41	Fixed, comp., 51k ohm ±5% ¼W	RC103-351	A-B	CB5135	1
43	Fixed, comp., 2.2M ohm ±5% ¼W	RC103-522	A-B	CB2255	-
"Q "	TRANSISTORS				
1	P.N.P. Silicon	QA042-500	FCD	2N4250	1
2,4,5	N Channel JFET	QA054-580	MOT	2N5458	3
3	P.N.P. Silicon	QB000-009	MOT	MPS3702	1

NOTE 1: FOR Z OF 50Ω, R74 IS CHANGED TO 50 AND THE "A" SUFFIX IS DROPPED FROM THE MODULE NUMBER

HETERODYNE SWEEP OSCILLATOR SCHEMATIC

MODULE M9JA 1 TO 300 MHz	MODULE M9KA 1 TO 400 MHz

REV A



MODULE M9JA M9KA REV B

WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
RC104-247	A-B	CB4721	8
RC104-047	A-B	CB4701	4
RC104-222	A-B	CB2221	2
RV102-310	BOU	3067P	1
RC104-256	A-B	CB5621	1
RC104-310	A-B	CB1031	4
RC104-010	A-B	CB1001	1
RC104-112	A-B	CB1211	2
RP129-210	CTS	360S	1
RC104-033	A-B	CB3301	2
RC104-110	A-B	CB1011	7
RC104-147	A-B	CB4711	6
RC104-215	A-B	CB1521	1
RC104-227	A-B	CB2731	1
RC104-133	A-B	CB1331	1
RC104-115	A-B	CB1511	1
RC104-022	A-B	CB2201	1
RC104-510	A-B	CB1051	1
RC104-522	A-B	CB2251	1
RP124-320	A-B	WA2G032	2
RC104-315	A-B	CB1531	1
RC104-447	A-B	CB4741	1
RC104-210	A-B	CB1021	2
RC104-212	A-B	CB1221	1
RC104-512	A-B	CB1251	2
RC104-227	A-B	CB2721	1
RC104-347	A-B	CB4731	1
RC104-122	A-B	CB2211	1
RC104-218	A-B	CB1821	4
RC104-118	A-B	CB1811	1
RC106-115	A-B	EB1511	1
RC104-R47	A-B	CB4761	2
RC106-110	A-B	EB1011	1
RC105-068	A-B	EB6805	1
RC103-082	A-B	CB8205	1
RF407-500	E-M	MF5C1%TO	1
QA051-790	RCA	2N5179	8
QB000-009	MOT	MPS3702	4
QA038-541	G-E	2N3854A	1
QA054-580	MOT	2N5458	1
QB000-010	SPR	TD101	1
QB000-018	SSS	SD1006	2
QB000-019	SSS	SD1005	1

PARTS LIST

MODULE M9JA M9KA REV B

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
	50 ohm VERSION (OMIT "A" SUFFIX)				
"J"	CONNECTORS				
2	Jack, receptacle 50 ohm	JF000-005	APL	27-9	1
"R"	RESISTORS				
74	Fixed, metal film 49.9 ohm ±1%	RF404-990	E-M	MM5C1%TO	1
	"-1" VERSION				
	CONNECTORS				
	Jack, receptacle, 50 ohm	JF000-005	APL	27-9	1
	RESISTORS				
	Fixed, comp., 22 ohm ±10% ¼W	RC104-022	A-B	CB2201	1

NOTE 1: AVAILABLE 500 TO 1000 MHz BY ADJUSTING LEAD LENGTHS

NOTE 2: "-1" VERSION = OMITS CKT. FROM PINS 4, 5 & 8 ARE OMITTED SHOWN IN - - - - LINES

NOTE 3: "A" VERSION = CHANGES OF PARTS AFFECTED ARE R8

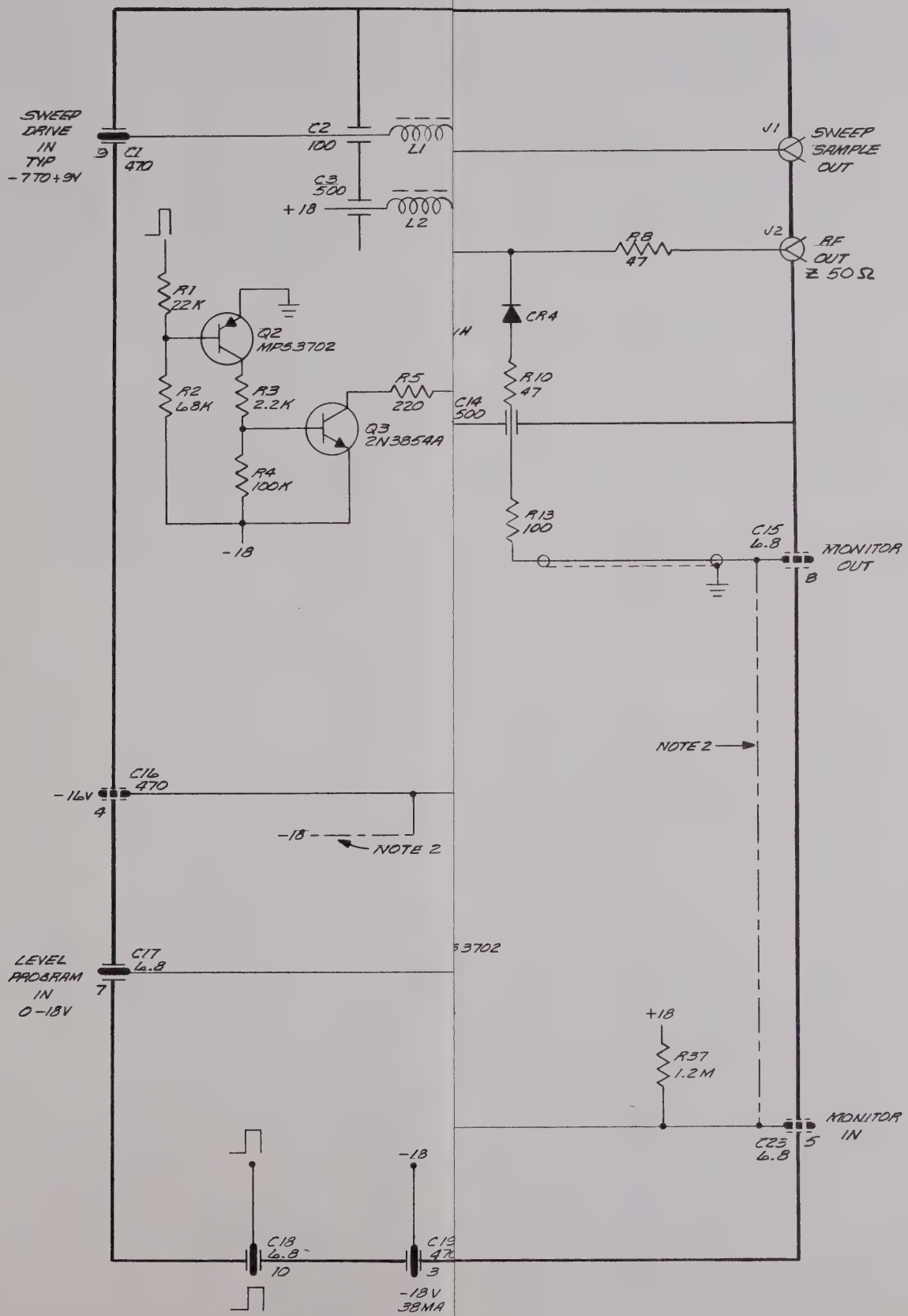
NOTE 4: Q6 AND Q7 UNASSIGNED

OSCILLATOR SCHEMATIC

450 TO 950 MHz (NOTE 1)

LE M9S "-1" VERSION (SEE NOTE 2)
"A" VERSION (SEE NOTE 3)

REV B



PARTS LIST — MODULE M9JA M9KA REV B

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"C ____"	CAPACITORS				
1	Composition .47pF ±10% 500V	CG101-147	Q-C	QC.47	1
2,4,11,13,16	Ceramic feedthru 500pF ±20% 250V	CF104-150	AER	EF4	11
17,25,28,32					
36,40					
3	Ceramic disc 100pF ±10% 1kV	CD108-110	RMC	C	1
5,6,7	Ceramic feedthru 100pF ±20% 250V	CF104-110	AER	EF4	3
8,43,45	Ceramic feedthru 470pF ±20% 500V	CF101-147	A-B	FA5C4711	3
9,12,14,24,	Electrolytic, .47uF ±10% 50V	CE113-447	TRW	935	12
30,31,33,34					
35,38,39,44					
10,23	Composition 3.9pF ±10% 500V	CG102-239	Q-C	MC39	2
15,18	Ceramic disc .01uF ±20% 100V	CD103-310	SPR	TG-S10	2
19,42	Ceramic feedthru 6.8pF ±10% 500V	CF102-R68	A-B	FA5C6895	2
20	Ceramic disc 270pF ±20% 1kV	CD102-127	SPR	5GA-T27	1
21	Ceramic disc 120pF ±20% 1kV	CD102-112	SPR	5GA-T12	1
22	Composition 4.7pF ±10% 500V	CG102-247	Q-C	MC4.7	1
26	Ceramic disc .025uF ±20% 100V	CD103-325	SPR	TG-S25	1
27	Composition 2.7pF ±10% 500V	CG101-227	Q-C	QC2.7	1
29	Ceramic disc 10pF ±.5% 1kV	CD101-010	SPR	10TCC-Q10	1
37	Ceramic disc 15pF ±5% 1kV	CD101-015	SPR	10TCC-Q15	1
41	Ceramic disc .001uF ±20% 1kV	CD102-210	SPR	5GA-D10	1
46	Electrolytic 10uF 25V	CE105-010	SPR	TE1204	1
"J ____"	CONNECTORS				
1,3	Jack, receptacle	JF000-005	SPL	27-9	2
2		JF000-004	APL	27-21	1
"CR ____"	DIODES				
1,2,3	Voltage variable capacitance	DC000-005	W-I	DC000-005	3
4,5,6,7,13	Silicon, point contact	DG100-821	SYL	1N82AS	5
8,9	Zener, 6.8V ±10%	DB000-001	CRL	HW6.8	2
10	Silicon junction 100piV 750mA	DR000-001	ITR	1N4002	1
11,12	Silicon P.I.N.	DP000-050	W-I	DP000-050	2
"L ____"	INDUCTORS				
1	Fixed ———	not assign	W-I	-----	--
2	Fixed ———	not assign	W-I	-----	--
3	Fixed ———	not assign	W-I	-----	--
4	Fixed ———	not assign	W-I	-----	--
5	Fixed ———	not assign	W-I	-----	--
6,7,13	Fixed .22uH	LA005-R02	W-E	506	3
8	Fixed ———	not assign	W-I	-----	--
9,10	Fixed ———	LA006-004	W-I	LA006-004	2
11,12,14,16	Fixed ———	LA006-010	W-I	LA006-010	7
18,19,22					
15,17,20	Fixed ———	not assign	W-I	-----	--
21	Fixed, 4.7uH	LA001-R47	JEF	15	1
"R ____"	RESISTORS				
1,10,58,64	Fixed, comp., 680 ohm ±10% ¼W	RC104-168	A-B	CB6811	4

PARTS LIST — MODULE M9JA M9KA REV B

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"R ____"	RESISTORS				
2,3,11,12	Fixed, comp., 4.7k ohm ±10% ¼W	RC104-247	A-B	CB4721	8
24,31,46,51					
4,23,33,70	Fixed, comp., 47 ohm ±10% ¼W	RC104-047	A-B	CB4701	4
5,55	Fixed, comp., 2.2k ohm ±10% ¼W	RC104-222	A-B	CB2221	2
6	Variable, wirewound, 10k ohm	RV102-310	BOU	3067P	1
7	Fixed, 5.6k ohm ±10% ¼W	RC104-256	A-B	CB5621	1
8,21,47,48	Fixed, 10k ohm ±10% ¼W	RC104-310	A-B	CB1031	4
9	Fixed, 10 ohm ±10% ¼W	RC104-010	A-B	CB1001	1
13,14	Fixed, 120 ohm ±10% ¼W	RC104-112	A-B	CB1211	2
15	Variable, cermet 1k ohm	RP129-210	CTS	360S	1
16,26	Fixed, comp., 33 ohm ±10% ¼W	RC104-033	A-B	CB3301	2
17,25,27,28	Fixed, comp., 100 ohm ±10% ¼W	RC104-110	A-B	CB1011	7
32,54, 73					
18,19,29,53	Fixed, comp., 470 ohm ±10% ¼W	RC104-147	A-B	CB4711	6
56,68					
20	Fixed, comp., 1.5k ohm ±10% ¼W	RC104-215	A-B	CB1521	1
22	Fixed, comp., 27k ohm ±10% ¼W	RC104-227	A-B	CB2731	1
30	Fixed, comp., 330 ohm ±10% ¼W	RC104-133	A-B	CB1331	1
34	Fixed, comp., 150 ohm ±10% ¼W	RC104-115	A-B	CB1511	1
35	Fixed, comp., 22 ohm ±10% ¼W	RC104-022	A-B	CB2201	1
36	Fixed, comp., 1M ohm ±10% ¼W	RC104-510	A-B	CB1051	1
37	Fixed, comp., 2.2M ohm ±10% ¼W	RC104-522	A-B	CB2251	1
38,39	Variable, carbon 20k ohm ±20%	RP124-320	A-B	WA2G032	2
40	Fixed, comp., 15k ohm ±10% ¼W	RC104-315	A-B	CB1531	1
41	Fixed, comp., 470k ohm ±10% ¼W	RC104-447	A-B	CB4741	1
42,71	Fixed, comp., 1k ohm ±10% ¼W	RC104-210	A-B	CB1021	2
43	Fixed, comp., 1.2k ohm ±10% ¼W	RC104-212	A-B	CB1221	1
44,49	Fixed, comp., 1.2M ohm ±10% ¼W	RC104-512	A-B	CB1251	2
45	Fixed, comp., 2.7k ohm ±10% ¼W	RC104-227	A-B	CB2721	1
50	Fixed, comp., 47k ohm ±10% ¼W	RC104-347	A-B	CB4731	1
52	Fixed, comp., 220 ohm ±10% ¼W	RC104-122	A-B	CB2211	1
57,62,63,67	Fixed, comp., 1.8k ohm ±10% ¼W	RC104-218	A-B	CB1821	4
59	Fixed, comp., 180 ohm ±10% ¼W	RC104-118	A-B	CB1811	1
60	Fixed, comp., 150 ohm ±10% ½W	RC106-115	A-B	EB1511	1
61,66	Fixed, comp., 4.7 ohm ±10% ¼W	RC104-R47	A-B	CB4761	2
65	Fixed, comp., 100 ohm ±10% ½W	RC106-110	A-B	EB1011	1
69	Fixed, comp., 68 ohm ±5% ¼W	RC105-068	A-B	EB6805	1
73	Fixed, comp., 82 ohm ±5% ¼W	RC103-082	A-B	CB8205	1
74	Fixed, metal film 75 ohm	RF407-500	E-M	MF5C1%TO	1
"Q ____"	TRANSISTORS				
1,2,4,5,8	NPN, Silicon	QA051-790	RCA	2N5179	8
9,10,11					
3,7,14,15	PNP, Silicon	QB000-009	MOT	MPS3702	4
6	NPN, Silicon	QA038-541	G-E	2N3854A	1
12	N channel JFET	QA054-580	MOT	2N5458	1
13	Dual NPN, Silicon	QB000-010	SPR	TD101	1
16,17	NPN, Silicon	QB000-018	SSS	SD1006	2
18	NPN, Silicon	QB000-019	SSS	SD1005	1

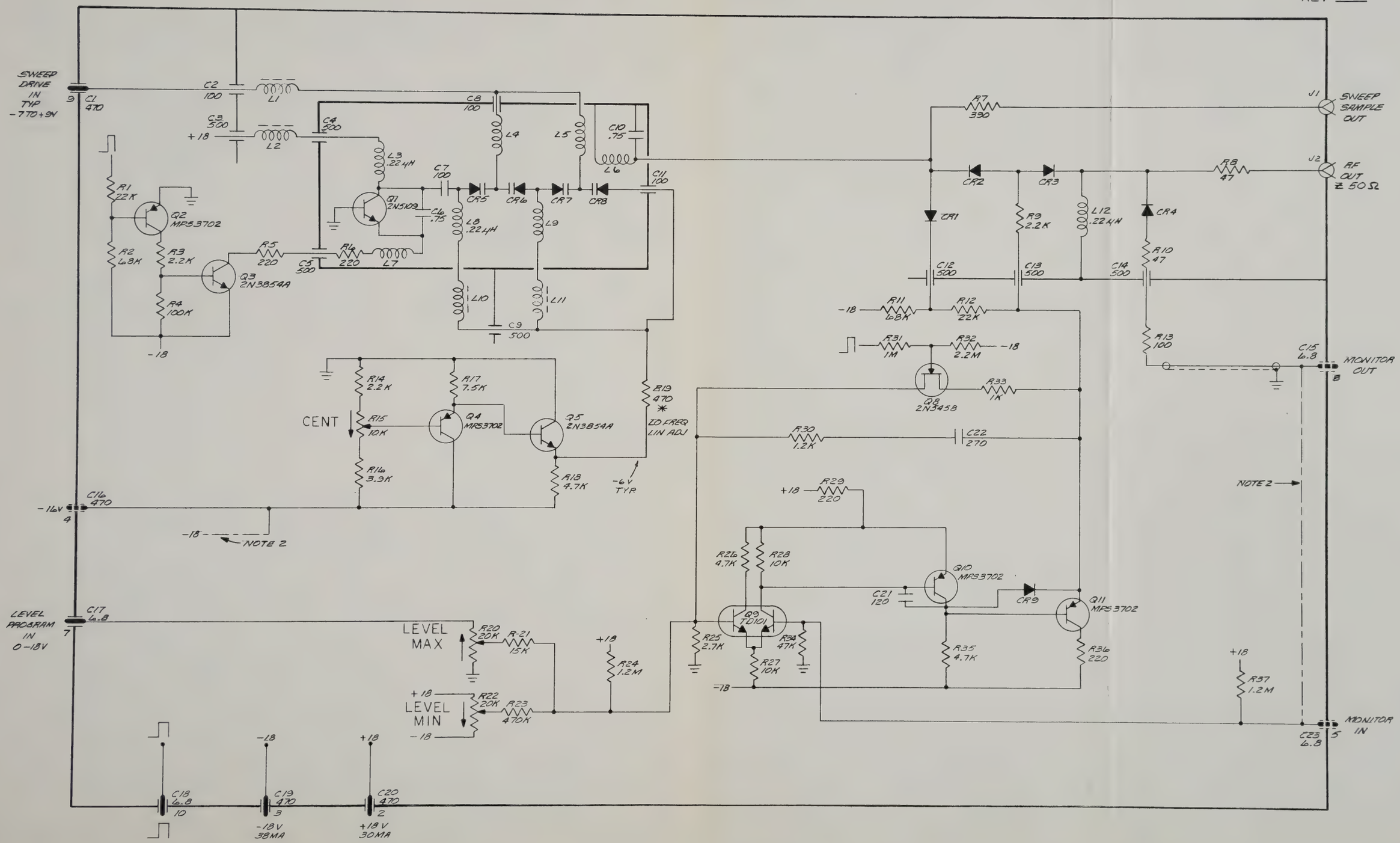
PARTS LIST — MODULE M9JA M9KA REV B

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
	50 ohm VERSION (OMIT "A" SUFFIX)				
"J ____"	CONNECTORS				
2	Jack, receptacle 50 ohm	JF000-005	APL	27-9	1
"R ____"	RESISTORS				
74	Fixed, metal film 49.9 ohm ±1%	RF404-990	E-M	MM5C1%TO	1
	"-1" VERSION				
	CONNECTORS				
	Jack, receptacle, 50 ohm	JF000-005	APL	27-9	1
	RESISTORS				
	Fixed, comp., 22 ohm ±10% ¼W	RC104-022	A-B	CB2201	1

NOTE 1: AVAILABLE 500 TO 1000 MHz RANGE BY ADJUSTING LEAD LENGTHS IN OSC. COMPARTMENT
NOTE 2: "-1" VERSION = OMITS CKT. FOR EXTERNAL MONITOR. PINS 4, 5 & 8 ARE OMITTED AND UNIT IS WIRED AS SHOWN IN - —— - LINES
NOTE 3: "A" VERSION = CHANGES OUTPUT IMPEDANCE TO 75 Ω. PARTS AFFECTED ARE R8 AND J2. (SEE PARTS LIST)
NOTE 4: Q6 AND Q7 UNASSIGNED

SWEEP OSCILLATOR SCHEMATIC
450 TO 950 MHz (NOTE 1)
MODULE M9S "-1" VERSION (SEE NOTE 2)
"A" VERSION (SEE NOTE 3)

REV B



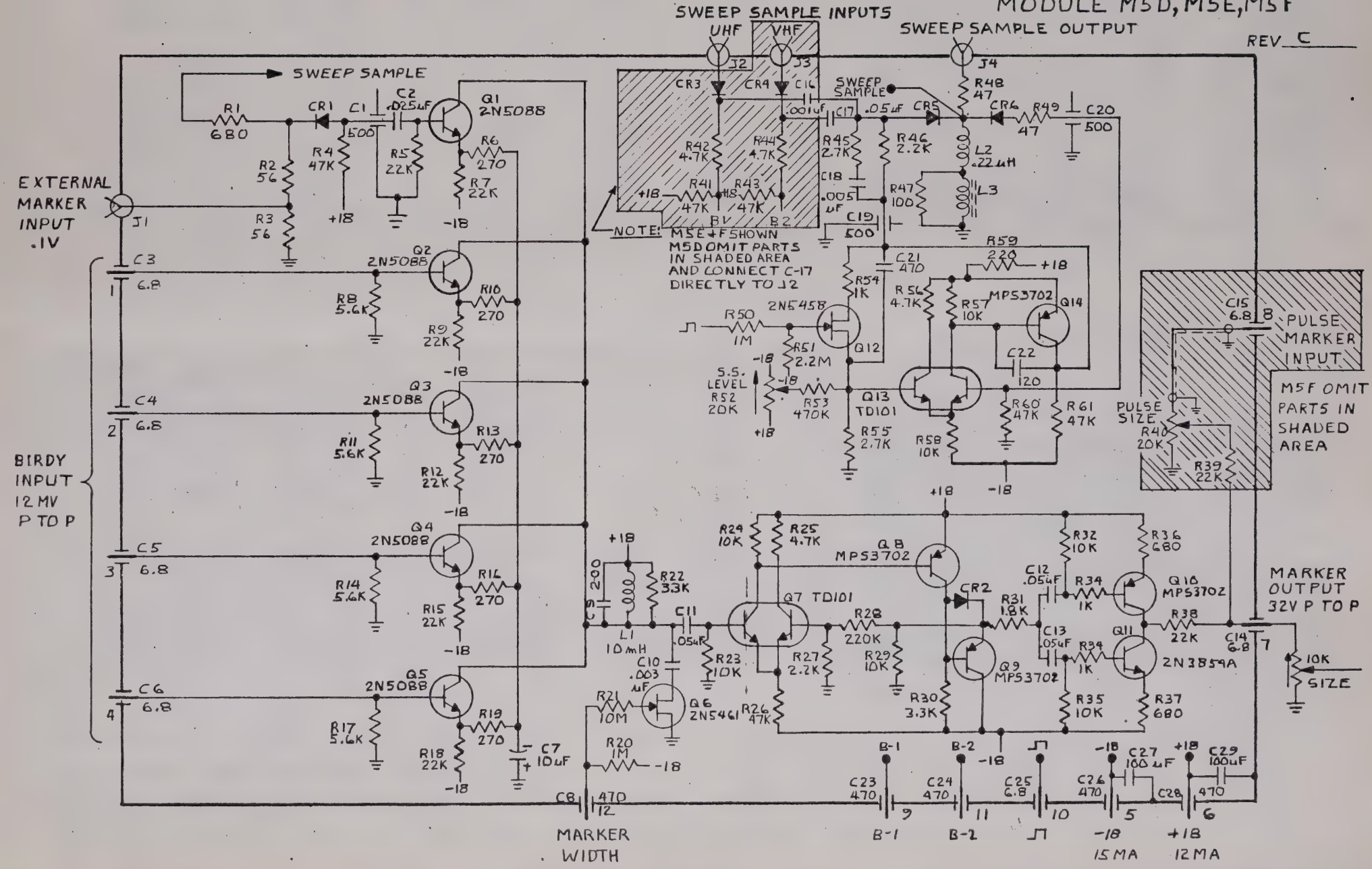
PARTS LIST

MODULE M9S-1 REV B

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"R"	RESISTORS				
32	Fixed, comp. 2.2Mohm ±10% ¼W	RC104-522	A-B	CB2251	1
33	Fixed, comp. 1Kohm ±10% ¼W	RC104-210	A-B	CB1021	1
34	Fixed, comp. 47Kohm ±10% ¼W	RC104-347	A-B	CB4731	1
"Q"	TRANSISTORS				
1	NPN, Silicon	QA051-090	SSS	2N5109	1
2,4,10,11	PNP, Silicon	QB000-009	MOT	MPS3702	4
3,5	NPN, Silicon	QA038-541	G-E	2N3854A	2
8	N-channel JFET	QA054-580	MOT	2N5458	1
9	Dual NPN Silicon	QB000-010	SPR	TD101	1
	"A" VERSION				
"J"	CONNECTORS				
2	Jack, receptacle 75ohm	JF000-004	APL	27-21	1
"R"	RESISTORS				
8	Fixed, metal film 75ohm ±1%	RF407-500	E-M	MF5C1%TO	1

MARKER ADDER SCHEMATIC
MODULE M5D, M5E, M5F

REV C



PARTS LIST — MODULE M9S-1 REV B

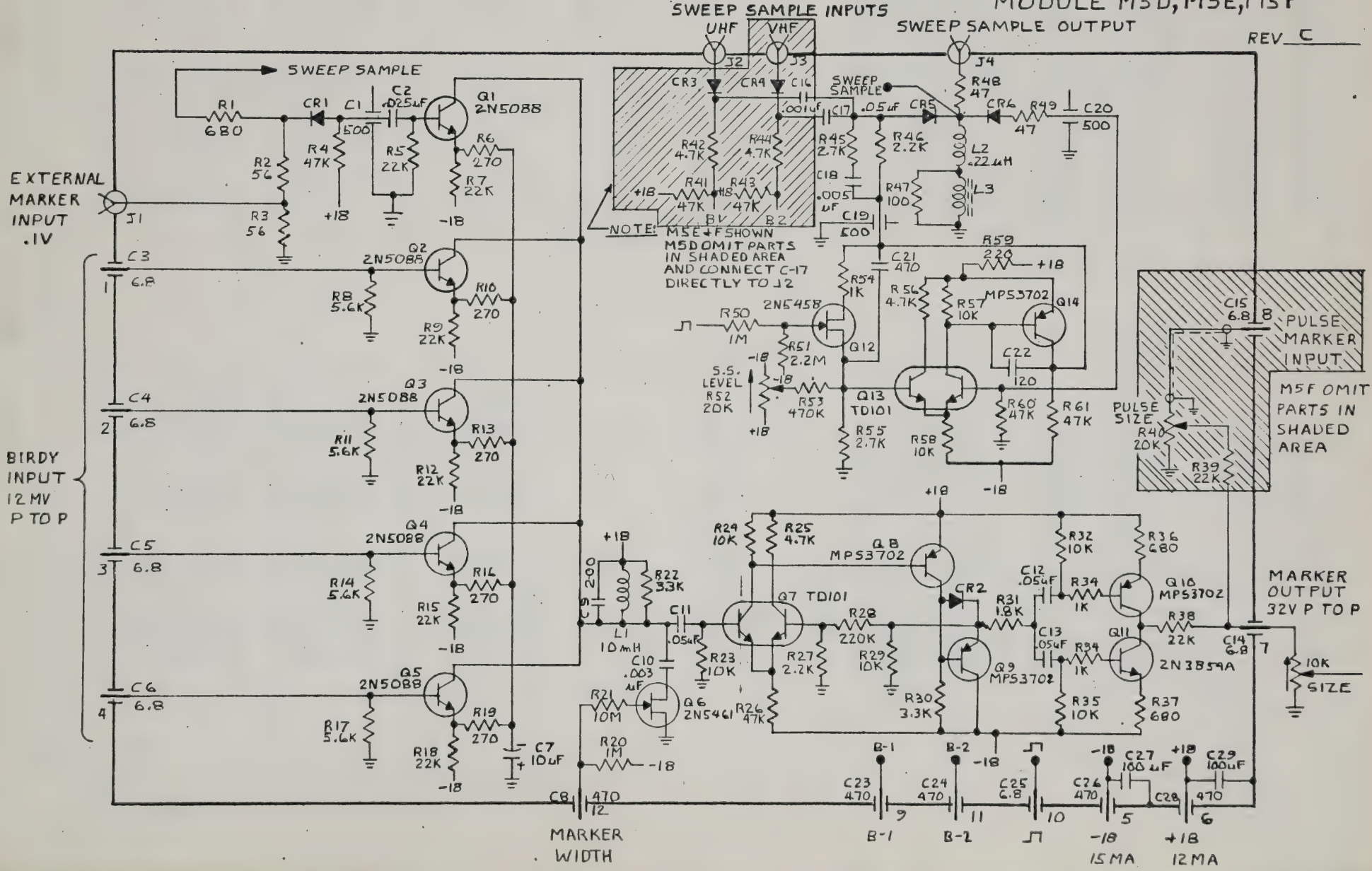
REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"C"	CAPACITORS				
1,16,19,20	Ceramic feedthru 470pF ±20% 500V	CF101-147	A-B	FA5C	3
2,7,8,11	Ceramic feedthru 100pF ±20% 250V	CF104-110	AER	EF4	4
3,4,5,9,12	Ceramic feedthru 500pF ±20% 250V	CF104-150	AER	EF4	7
13,14					
6	Composition, .75pF ±10% 500V	CG101-175	Q-C	QC.75	1
10	Composition .75pF ±10% 500V	CG102-175	Q-C	MC.75	1
15,17,18,23	Ceramic feedthru 6.8pF ±10% 500V	CF102-R68	A-B	FA5C	2
21	Ceramic disc 120pF ±20% 1kV	CD102-112	SPR	5GA-T12	1
22	Ceramic disc 270pF ±20% 1kV	CD102-127	SPR	5GA-T27	1
"J"	CONNECTORS				
1,2	Jack, receptacle, 50 ohm	JF000-005	APL	27-9	2
"CR"	DIODES				
1,2,3	Silicon, P.I.N.	DP000-040	W-I	DP000-040	3
4	Silicon, Point contact	DG100-821	SYL	1N82AS	1
5,6,7,8	Voltage variable capacitance	DC000-008	W-I	DC000-008	4
9	Silicon, junction 100 P.I.V. 750 mA	DR000-001	ITR	1N4002	1
"L"	INDUCTORS				
1,2,10,11	Fixed ———	LA006-004	W-I	LA006-004	4
3,8,12	Fixed, .22uH	LA005-R02	W-E	506	3
4	Fixed ———	Not Assign	W-I	Not Assign	-
5,7,9	Fixed ———	Not Assign	W-I	Not Assign	-
6	Fixed ———	Not Assign	W-I	Not Assign	-
"R"	RESISTORS				
1,12	Fixed, comp. 22Kohm ±10% ¼W	RC104-322	A-B	CB2231	2
2,11	Fixed, comp. 68Kohm ±10% ¼W	RC104-368	A-B	CB6831	2
3,9,14	Fixed, comp. 2.2Kohm ±10% ¼W	RC104-222	A-B	CB2221	3
4	Fixed, comp. 100Kohm ±10% ¼W	RC104-410	A-B	CB1041	1
5,6	Fixed, comp. 220ohm ±10% ½W	RC106-122	A-B	EB2211	2
7	Fixed, comp. 390ohm ±10% ¼W	RC104-139	A-B	CB3911	1
8	Fixed, comp. 47ohm ±5% ½W	RC105-047	A-B	EB4705	1
10	Fixed, comp. 47ohm ±10% ¼W	RC104-047	A-B	CB4701	1
13	Fixed, comp. 100ohm ±10% ¼W	RC104-110	A-B	CB1011	1
15	Variable, wirewound 10Kohm	RV102-310	BOU	3067P	1
16	Fixed, comp. 3.9Kohm ±10% ¼W	RC104-239	A-B	CB2391	1
17	Fixed, comp. 7.5Kohm ±5% ¼W	RC103-275	A-B	CB7525	1
18,26,35	Fixed, comp. 4.7Kohm ±10% ¼W	RC104-247	A-B	CB4721	3
19	Fixed, comp. 470ohm ±10% ¼W	RC104-147	A-B	CB4711	1
20,22	Variable, carbon 20Kohm ±20%	RP124-320	A-B	WA2G032	2
21	Fixed, comp. 15Kohm ±10% ¼W	RC104-315	A-B	CB1531	1
23	Fixed, comp. 470Kohm ±10% ¼W	RC104-447	A-B	CB4741	1
24,37	Fixed, comp. 1.2Mohm ±10% ¼W	RC104-512	A-B	CB1251	2
25	Fixed, comp. 2.7Kohm ±10% ¼W	RC104-227	A-B	CB2721	1
27,28	Fixed, comp. 10Kohm ±10% ¼W	RC104-310	A-B	CB1031	2
29,36	Fixed, comp. 220 ohm ±10% ¼W	RC104-122	A-B	CB2211	2
30	Fixed, comp. 1.2Kohm ±10% ¼W	RC104-212	A-B	CB1221	1
31	Fixed, comp. 1Mohm ±10% ¼W	RC104-510	A-B	CB1051	1

PARTS LIST — MODULE M9S-1 REV B

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"R"	RESISTORS				
32	Fixed, comp. 2.2Mohm ±10% ¼W	RC104-522	A-B	CB2251	1
33	Fixed, comp. 1Kohm ±10% ¼W	RC104-210	A-B	CB1021	1
34	Fixed, comp. 47Kohm ±10% ¼W	RC104-347	A-B	CB4731	1
"Q"	TRANSISTORS				
1	NPN, Silicon	QA051-090	SSS	2N5109	1
2,4,10,11	PNP, Silicon	QB000-009	MOT	MPS3702	4
3,5	NPN, Silicon	QA038-541	G-E	2N3854A	2
8	N-channel JFET	QA054-580	MOT	2N5458	1
9	Dual NPN Silicon	QB000-010	SPR	TD101	1
	"A" VERSION				
"J"	CONNECTORS				
2	Jack, receptacle 75ohm	JF000-004	APL	27-21	1
"R"	RESISTORS				
8	Fixed, metal film .75ohm ±1%	RF407-500	E-M	MF5C1%TO	1

MARKER ADDER SCHEMATIC
MODULE M5D, M5E, M5F

REV C



PARTS LIST

MODULE M5D REV C

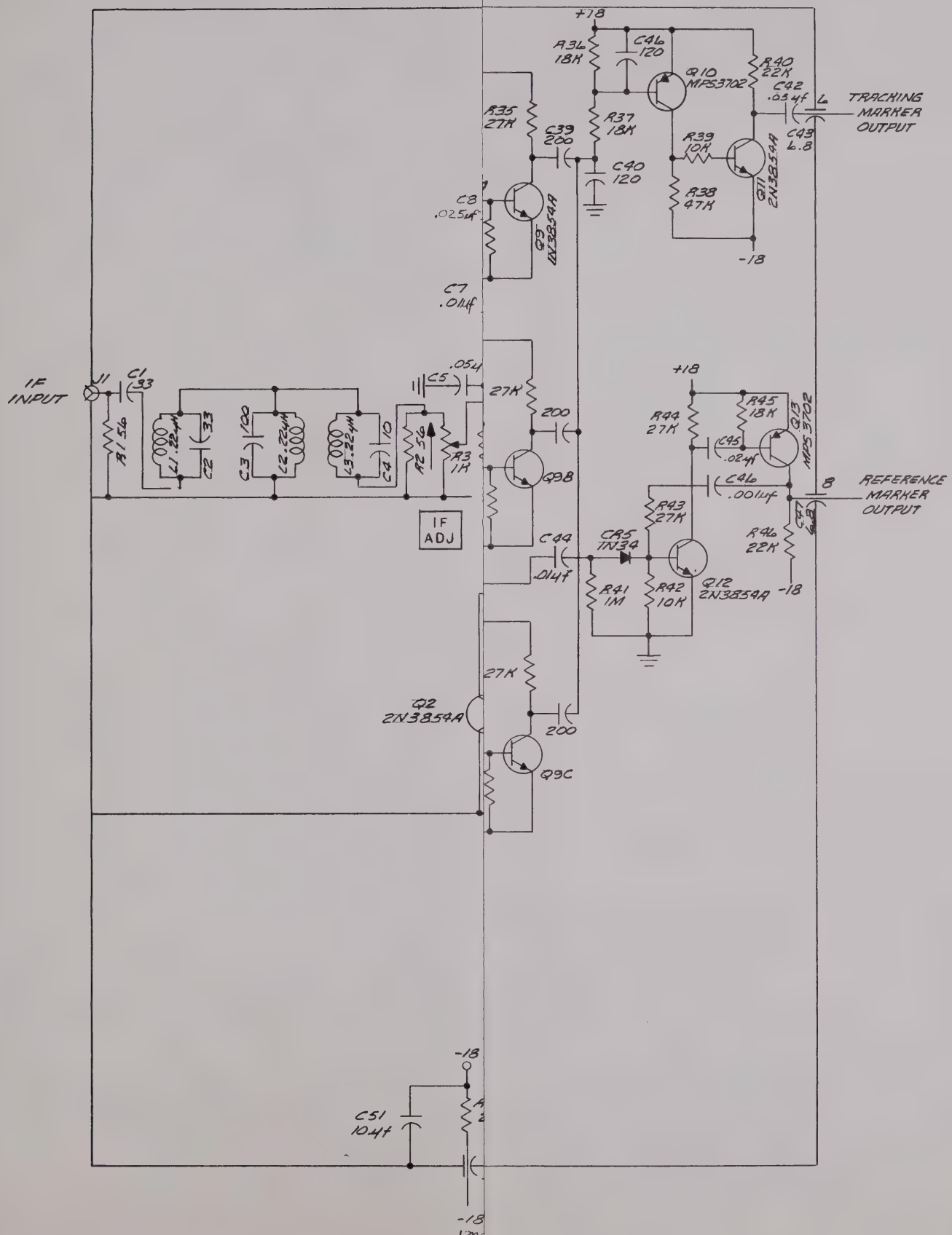
REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"C "	CAPACITORS				
1,19,20	Ceramic feedthru, 500pF ±20% 250V	CF104-150	AER	EF4	3
2	Ceramic disc., .025uF ±20% 100V	CD103-325	SPR	TG-S25	1
3,4,5,6,14 15,25	Ceramic feedthru, 6.8pF ±10% 500V	CF102-R68	A-B	FA5C	7
7	Electrolytic, 10uF 25V	CE105-010	SPR	TE-1204	1
8,23,24,26 28	Ceramic feedthru, 470pF ±20% 500V	CF101-147	A-B	FA5C	5
9	Ceramic disc., 200pF ±20% 1kV	CD102-120	SPR	5GA-T20	1
10	Ceramic disc., .003uF ±20% 1kV	CD102-230	SPR	5GA-D30	1
11,12,13,17	Ceramic disc., .05uF ±20% 100V	CD103-350	SPR	TG-S50	4
18	Ceramic disc., .005uF ±20% 100V	CD103-250	SPR	TG-D50	1
21	Ceramic disc., 470pF ±20% 1kV	CD102-147	SPR	5GA-T47	1
22	Ceramic disc., 120pF ±20% 1kV	CD102-112	SPR	5GA-T12	1
27,29	Electrolytic, 100uF 25V	CE104-110	SPR	TE-1211	2
"J "	CONNECTORS				
1,2,4	Jack, receptacle, 50 Ω, subminiature	JF000-005	APL	27-9	4
"CR "	DIODES				
1,6	SIlicon, point contact	DG100-821	SYL	1N82AS	2
2	Silicon, junction, 100piV 750mA	DR000-001	ITT	1N4002	1
5	Silicon, P.I.N.	DP000-040	W-I	DP000-040	1
"L "	INDUCTORS				
1	Fixed, 10mH	LA004-310	JEF	15S103K	1
2	Fixed, .22uH	LA005-R02	W-E	506	1
3	Fixed, -----	LA006-010	W-I	LA006-010	1
"R "	RESISTORS				
1,36,37	Fixed, comp., 680 Ω ±10% ¼W	RC104-168	A-B	CB6811	3
2,3	Fixed, comp., 56 Ω ±10% ¼W	RC104-056	A-B	CB5601	2
4,26,60,61	Fixed, comp., 47k Ω ±10% ¼W	RC104-347	A-B	CB4731	4
5,7,9,12,15 18,38,39	Fixed, comp., 22k Ω ±10% ¼W	RC104-322	A-B	CB2231	8
6,10,13,16 19	Fixed, comp., 270 Ω ±10% ¼W	RC104-127	A-B	CB2711	5
8,11,14,17	Fixed, comp., 5.6k Ω ±10% ¼W	RC104-256	A-B	CB5621	4
20,50	Fixed, comp., 1M Ω ±10% ¼W	RC104-510	A-B	CB1051	2
21	Fixed, comp., 10M Ω ±10% ¼W	RC104-610	A-B	CB1061	1
22,30	Fixed, comp., 3.3k Ω ±10% ¼W	RC104-233	A-B	CB3321	2
23,24,29,32 35,57,58	Fixed, comp., 10k Ω ±10% ¼W	RC104-310	A-B	CB1031	7
25,56	Fixed, comp., 4.7k Ω ±10% ¼W	RC104-247	A-B	CB4721	2
27,46	Fixed, comp., 2.2k Ω ±10% ¼W	RC104-222	A-B	CB2221	2
28	Fixed, comp., 220k Ω ±10% ¼W	RC104-422	A-B	CB2241	1
31	Fixed, comp., 1.8k Ω ±10% ¼W	RC104-218	A-B	CB1821	1
33,34,54	Fixed, comp., 1k Ω ±10% ¼W	RC104-210	A-B	CB1021	3
40,52	Variable, carbon 20k Ω±20% ¼W	RP124-320	A-B	WA2G032	2
45,55	Fixed, comp., 2.7k Ω ±10% ¼W	RC104-227	A-B	CB2721	2

PARTS LIST

MODULE M5D REV C

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"R"	RESISTORS				
47	Fixed, comp., 100 Ω ±10% ¼W	RC104-110	A-B	CB1011	1
48	Fixed, comp., 47 Ω ±5% ½W	RC105-047	A-B	EB4705	1
49	Fixed, comp., 47 Ω ±5% ¼W	RC103-047	A-B	CB4705	1
51	Fixed, comp., 2.2M Ω ±10% ¼W	RC104-522	A-B	CB2251	1
53	Fixed, comp., 470k Ω ±10% ¼W	RC104-447	A-B	CB4741	1
59	Fixed, comp., 220 Ω ±10% ¼W	RC104-122	A-B	CB2211	1
"Q"	TRANSISTORS				
1,2,3,4,5	NPN, Silicon	QA050-880	MOT	2N5088	5
6	P-channel, JFET	QA054-610	MOT	2N5461	1
7,13	Dual, NPN, Silicon	QB000-010	SPR	TD101	2
8,9,10,14	PNP, Silicon	QB000-009	MOT	MPS3702	4
11	NPN, Silicon	QA038-541	G-E	2N3854A	1
12	N-channel, JFET	QA054-580	MOT	2N5458	1

ING MARKER SCHEMATIC
3 MODULE M7E REV B



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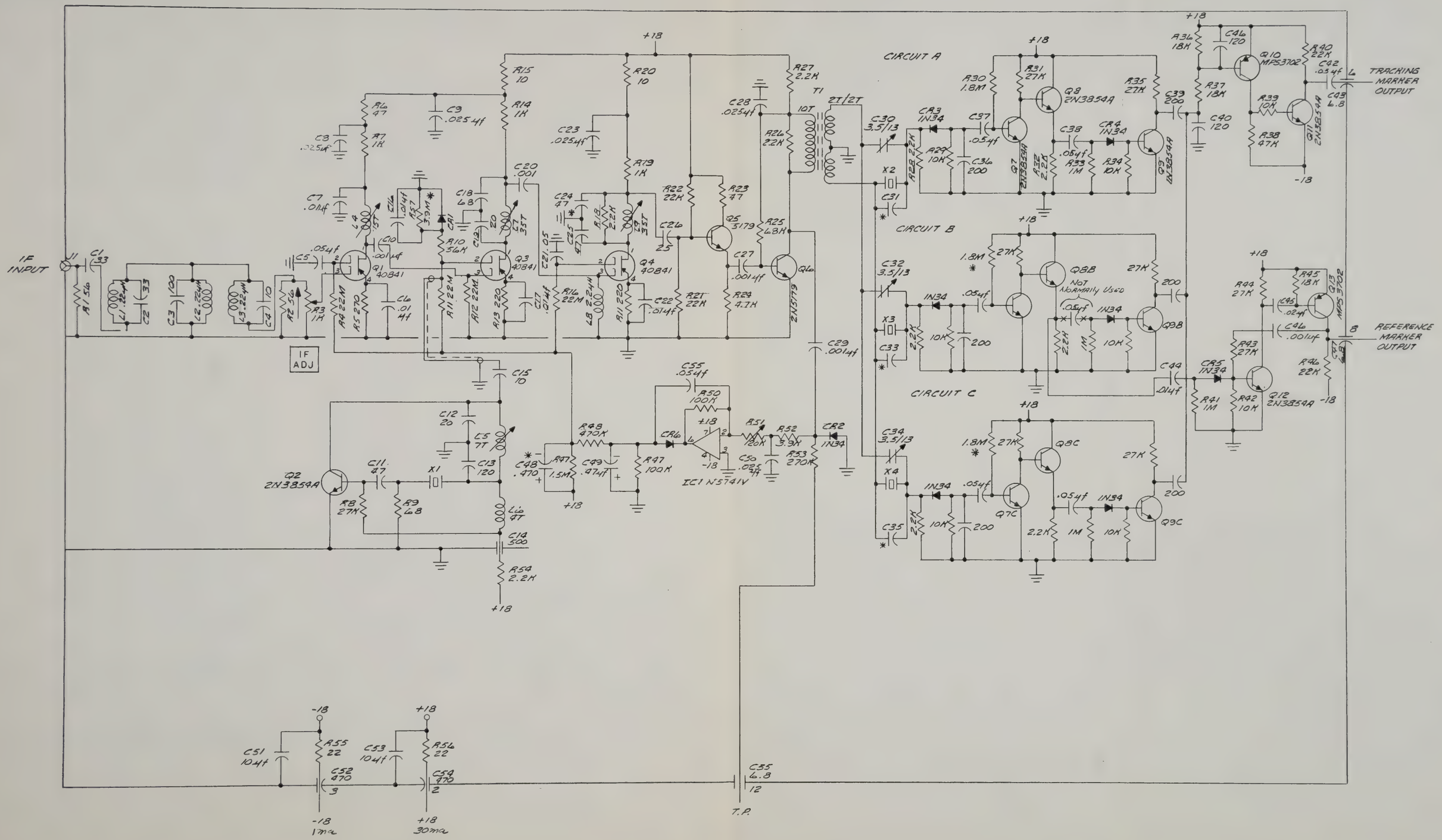
OPTION B MODULE M7E REV B

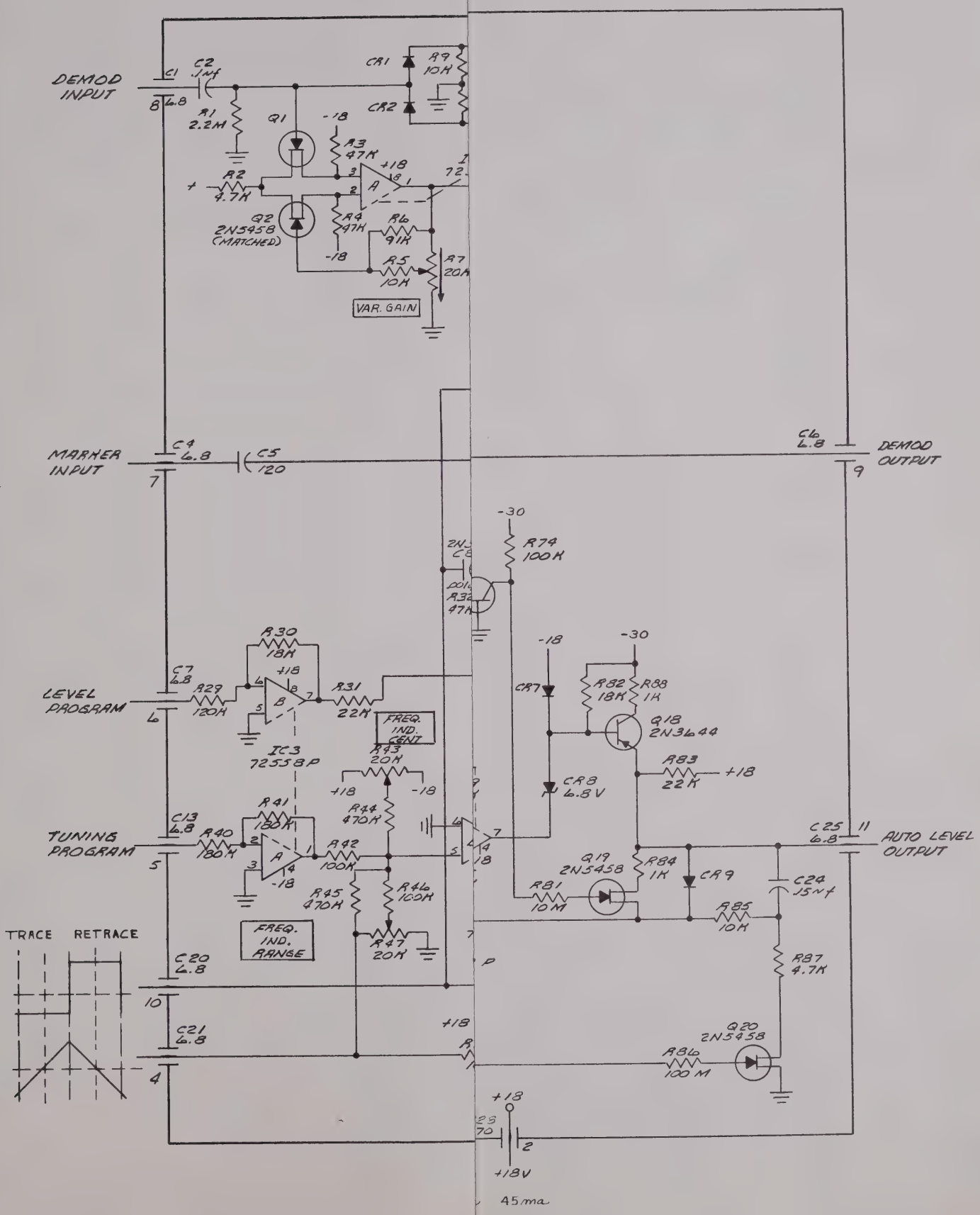


PARTS LIST

MODULE M7E REV B

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"IC "	INTEGRATED CIRCUITS				
1	Operational amplifier, 8 pin, in line	IC000-002	SIG	N5741V	1
"R "	RESISTORS				
1,2	Fixed, comp., 56 ohm ±10% ¼W	RC104-056	A-B	CB5601	2
3	Variable carbon 1k ohm ±20%	RP124-210	A-B	WA2G032	1
4,11,16	Fixed, comp., 22M ohm ±10% ¼W	RC104-622	A-B	CB2261	3
5,13,17	Fixed, comp., 220 ohm ±10% ¼W	RC104-122	A-B	CB2211	3
6,23	Fixed, comp., 47 ohm ±10% ¼W	RC104-047	A-B	CB4701	2
7,14,19	Fixed, comp., 1k ohm ±10% ¼W	RC104-210	A-B	CB1021	3
8,31A,B,C 35A,B,C,43, 44	Fixed, comp., 27k ohm ±10% ¼W	RC104-327	A-B	CB2731	9
9	Fixed, comp., 68 ohm ±10% ¼W	RC104-068	A-B	CB6801	1
10	Fixed, comp., 56k ohm ±10% ¼W	RC104-356	A-B	CB5631	1
12,21,22,40 46	Fixed, comp, comp., 22k ohm ±10% ¼W	RC104-322	A-B	CB2231	5
15,20	Fixed, comp., 10 ohm ±10% ¼W	RC104-010	A-B	CB1001	2
18,26,27,28A B,C,32A,B,C, 54	Fixed, comp., 2.2k ohm ±10% ¼W	RC104-222	A-B	CB2221	10
24	Fixed, comp., 4.7k ohm ±19% ¼W	RC104-247	A-B	CB4721	1
25	Fixed, comp., 68k ohm ±10% ¼W	RC104-368	A-B	CB6831	1
29A,B,C,34 A,B,C,39,42	Fixed, comp., 10k ohm ±10% ¼W	RC104-310	A-B	CB1031	8
30A,B,C,	Fixed, comp., 1.8M ohm ±5% ¼W	RC103-518	A-B	CB1855	3
33A,B,C,41	Fixed, comp., 1M ohm ±10% ¼W	RC104-510	A-B	CB1051	4
36,37,45	Fixed, comp., 18k ohm ±10% ¼W	RC104-318	A-B	CB1831	3
38	Fixed, comp., 47k ohm ±10% ¼W	RC104-347	A-B	CB4731	1
47	Fixed, comp., 1.5M ohm ±10% ¼W	RC104-515	A-B	CB1551	1
48	Fixed, comp., 470k ohm ±10% ¼W	RC104-447	A-B	CB4741	1
49,50	Fixed, comp., 100k ohm ±10% ¼W	RC104-410	A-B	CB1041	2
51	Variable, cermet 20k ohm ±20%	RP129-320	CTS	360S	1
52	Fixed, comp., 3.9k ohm ±10% ¼W	RC104-239	A-B	CB3921	1
53	Fixed, comp., 270k ohm ±10% ¼W	RC104-427	A-B	CB2741	1
55,56	Fixed, comp., 22 ohm ±10% ¼W	RC104-022	A-B	CB2201	2
57*	Fixed, comp., 3.9M ohm ±10% ¼W	RC104-539	A-B	CB3951	
"T "	TRANSFORMERS				
1	10 turn Prim, 2 turn, 2 turn sec.	not assign	W-I	-----	--
"Q "	TRANSISTORS				
1,3,4	N channel dual gate IGFET	QB000-020	RCA	40841	3
2,7A,B,C,8A B,C,9A,B,C 11,12	NPN Silicon	QA038-541	G-E	2N3854A	12
5,6	NPN, Silicon	QA051-790	RCA	2N5179	2
10,13	PNP, Silicon	QB000-009	MOT	MPS3702	2

SCOPE INDICATOR SCHEMATIC
M8E REV C



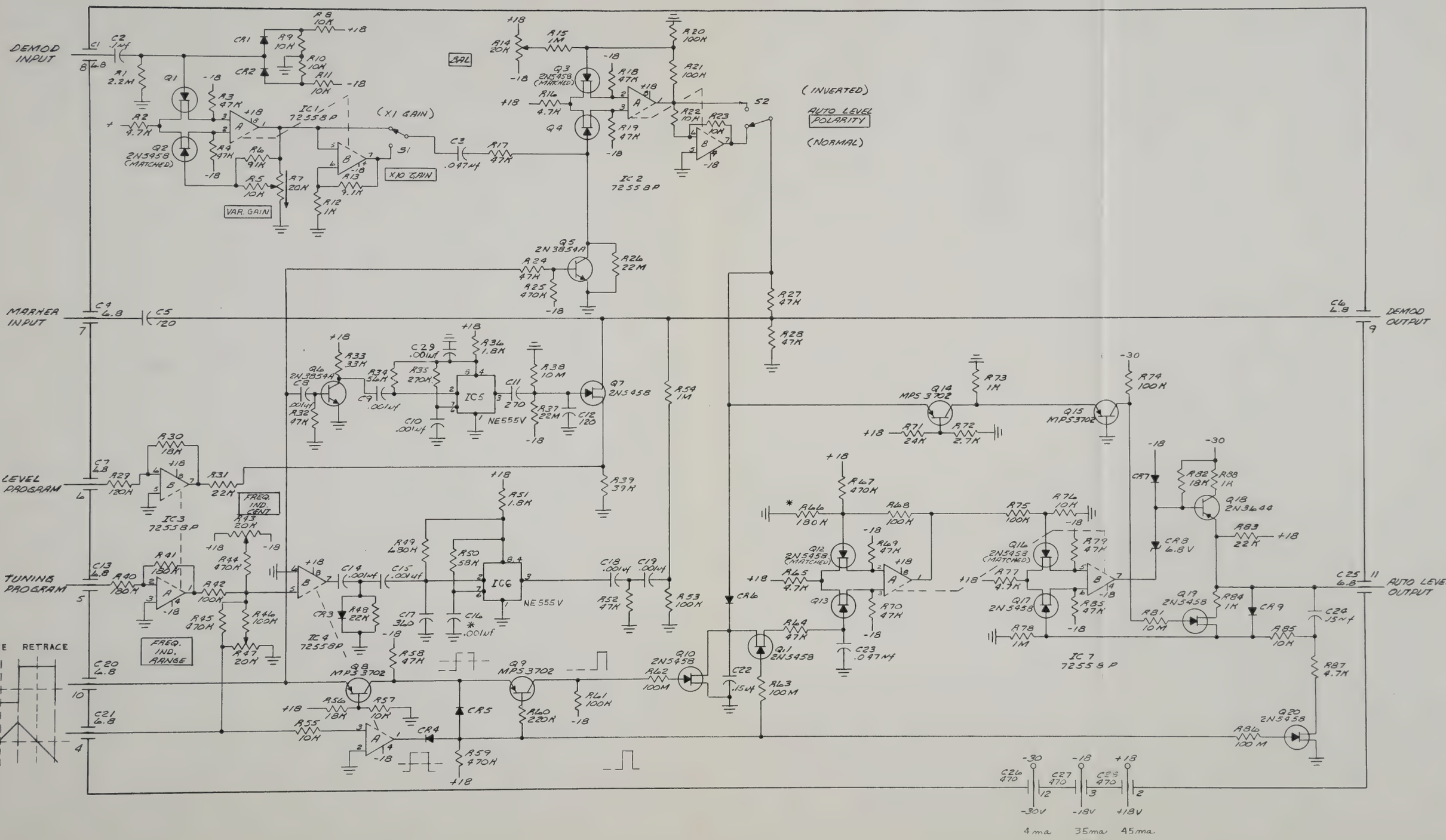
PARTS LIST — MODULE M7E REV B

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"C ____"	CAPACITORS				
1,2	Ceramic disc, 33pF ±5% 1kV	CD101-033	SPR	10TCC-Q33	2
3	Ceramic disc, 100pF ±20% 1kV	CD102-110	SPR	5GA-T10	1
4,15	Ceramic disc, 10pF ±5% 1kV	CD101-010	SPR	10TCC-Q10	2
5,21,37A,B,C,38A,B,C,42,55*	Ceramic disc, .05uF ±20% 100V	CD103-350	SPR	TG-S50	9
6,7,16,17,22,44	Ceramic disc, .01uF ±20% 100V	CD103-310	SPR	TG-S10	6
8.9.23,28,50	Ceramic disc, .025uF ±20% 100V	CD103-325	SPR	TG-S25	5
10,20,27,2946	Ceramic disc, .001uF ±20% 1kV	CD102-210	SPR	5GA-D10	5
11,24,25	Ceramic disc, 47pF ±5% 1kV	CD104-047	SPR	10TCC-Q47	3
12,19	Ceramic disc, 20pF ±5% 1kV	CD101-020	SPR	10TCC-Q20	2
13,40,41	Ceramic disc, 120pF ±5% 1kV	CD104-112	SPR	10TCU-T12	3
14	Ceramic feedthru, 500pF ±20% 250V	CF104-150	AER	EF4	1
18	Ceramic disc, 68pF ±5% 1kV	CD104-068	SPR	10TCU-Q68	1
26	Ceramic disc, 25pF ±5% 1kV	CD101-025	SPR	10TCC-Q25	1
30,32,34	Variable ceramic, 3.5/13pF 150V	CV101-013	STE	7S-TRIKO	3
31,33,35*	Composition, 2pF ±10% 500V	CG101-220	Q-C	QC2.0	
36A,B,C,39AB,C	Ceramic disc, 200pF ±20% 1kV	CD102-120	SPR	5GA-T20	6
43,47,55	Ceramic feedthru, 6.8pF ±10% 500V	CF102-R68	A-B	FA5C	3
45	Ceramic disc, .02uF ±20% 100V	CD103-320	SPR	TG-S20	1
48*,49	Electrolytic, .47uF ±10% 50V	CE113-447	TRW	935	2
51,53	Electrolytic, 10uF 50V	CE105-010	SPR	TE1204	2
52,54	Ceramic feedthru, 470pF ±20% 500V	CF101-147	A-B	FA5C	2
"J ____"	CONNECTORS				
1	Jack receptacle, 50 ohm subminiature	JF000-005	APL	27-9	1
"X ____"	CRYSTALS				
1	X33W	XX000-331	W-I	XX000-331	1
2	X36W	XX000-361	W-I	XX000-361	1
3	X36W	XX000-361	W-I	XX000-361	1
4	X36W at 10.0000 MHz	XX000-361	W-I	XX000-361	1
"CR ____"	DIODES				
1,6	Silicon, Junction, 100piV 750mA	DR000-001	ITR	1N4002	2
2,3A,B,C,4A,B,C,5	Germanium, point contact	DG100-341	SYL	1N34AS	8
"L ____"	INDUCTORS				
1,2,3	Fixed, .22uH	LA001-R02	JEF	15	3
4	Variable ----	not assign	W-I	----	--
5	Variable	not assign	W-I	----	--
6	Fixed ----	LA006-004	W-I	LA006-004	1
7	Variable	not assign	W-I	----	--
8	Fixed, 2.2uH ±10%	LA001-R22	JEF	15	1
9	Variable ----	not assign	W-I	----	--

PARTS LIST — MODULE M7E REV B

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"IC ____"	INTEGRATED CIRCUITS				
1	Operational amplifier, 8 pin, in line	IC000-002	SIG	N5741V	1
"R ____"	RESISTORS				
1,2	Fixed, comp., 56 ohm ±10% ¼W	RC104-056	A-B	CB5601	2
3	Variable carbon 1k ohm ±20%	RP124-210	A-B	WA2G032	1
4,11,16	Fixed, comp., 22M ohm ±10% ¼W	RC104-622	A-B	CB2261	3
5,13,17	Fixed, comp., 220 ohm ±10% ¼W	RC104-122	A-B	CB2211	3
6,23	Fixed, comp., 47 ohm ±10% ¼W	RC104-047	A-B	CB4701	2
7,14,19	Fixed, comp., 1k ohm ±10% ¼W	RC104-210	A-B	CB1021	3
8,31A,B,C 35A,B,C,43,44	Fixed, comp., 27k ohm ±10% ¼W	RC104-327	A-B	CB2731	9
9	Fixed, comp., 68 ohm ±10% ¼W	RC104-068	A-B	CB6801	1
10	Fixed, comp., 56k ohm ±10% ¼W	RC104-356	A-B	CB5631	1
12,21,22,4046	Fixed, comp, comp., 22k ohm ±10% ¼W	RC104-322	A-B	CB2231	5
15,20	Fixed, comp., 10 ohm ±10% ¼W	RC104-010	A-B	CB1001	2
18,26,27,28AB,C,32A,B,C,54	Fixed, comp., 2.2k ohm ±10% ¼W	RC104-222	A-B	CB2221	10
24	Fixed, comp., 4.7k ohm ±19% ¼W	RC104-247	A-B	CB4721	1
25	Fixed, comp., 68k ohm ±10% ¼W	RC104-368	A-B	CB6831	1
29A,B,C,34A,B,C,39,42	Fixed, comp., 10k ohm ±10% ¼W	RC104-310	A-B	CB1031	8
30A,B,C,	Fixed, comp., 1.8M ohm ±5% ¼W	RC103-518	A-B	CB1855	3
33A,B,C,41	Fixed, comp., 1M ohm ±10% ¼W	RC104-510	A-B	CB1051	4
36,37,45	Fixed, comp., 18k ohm ±10% ¼W	RC104-318	A-B	CB1831	3
38	Fixed, comp., 47k ohm ±10% ¼W	RC104-347	A-B	CB4731	1
47	Fixed, comp., 1.5M ohm ±10% ¼W	RC104-515	A-B	CB1551	1
48	Fixed, comp., 470k ohm ±10% ¼W	RC104-447	A-B	CB4741	1
49,50	Fixed, comp., 100k ohm ±10% ¼W	RC104-410	A-B	CB1041	2
51	Variable, cermet 20k ohm ±20%	RP129-320	CTS	360S	1
52	Fixed, comp., 3.9k ohm ±10% ¼W	RC104-239	A-B	CB3921	1
53	Fixed, comp., 270k ohm ±10% ¼W	RC104-427	A-B	CB2741	1
55,56	Fixed, comp., 22 ohm ±10% ¼W	RC104-022	A-B	CB2201	2
57*	Fixed, comp., 3.9M ohm ±10% ¼W	RC104-539	A-B	CB3951	
"T ____"	TRANSFORMERS				
1	10 turn Prim, 2 turn, 2 turn sec.	not assign	W-I	-----	--
"Q ____"	TRANSISTORS				
1,3,4	N channel dual gate IGFET	QB000-020	RCA	40841	3
2,7A,B,C,8AB,C,9A,B,C 11,12	NPN Silicon	QA038-541	G-E	2N3854A	12
5,6	NPN, Silicon	QA051-790	RCA	2N5179	2
10,13	PNP, Silicon	QB000-009	MOT	MPS3702	2

AUTOMATIC LEVEL & SCOPE INDICATOR SCHEMATIC
OPTION C MODULE M8E REV C

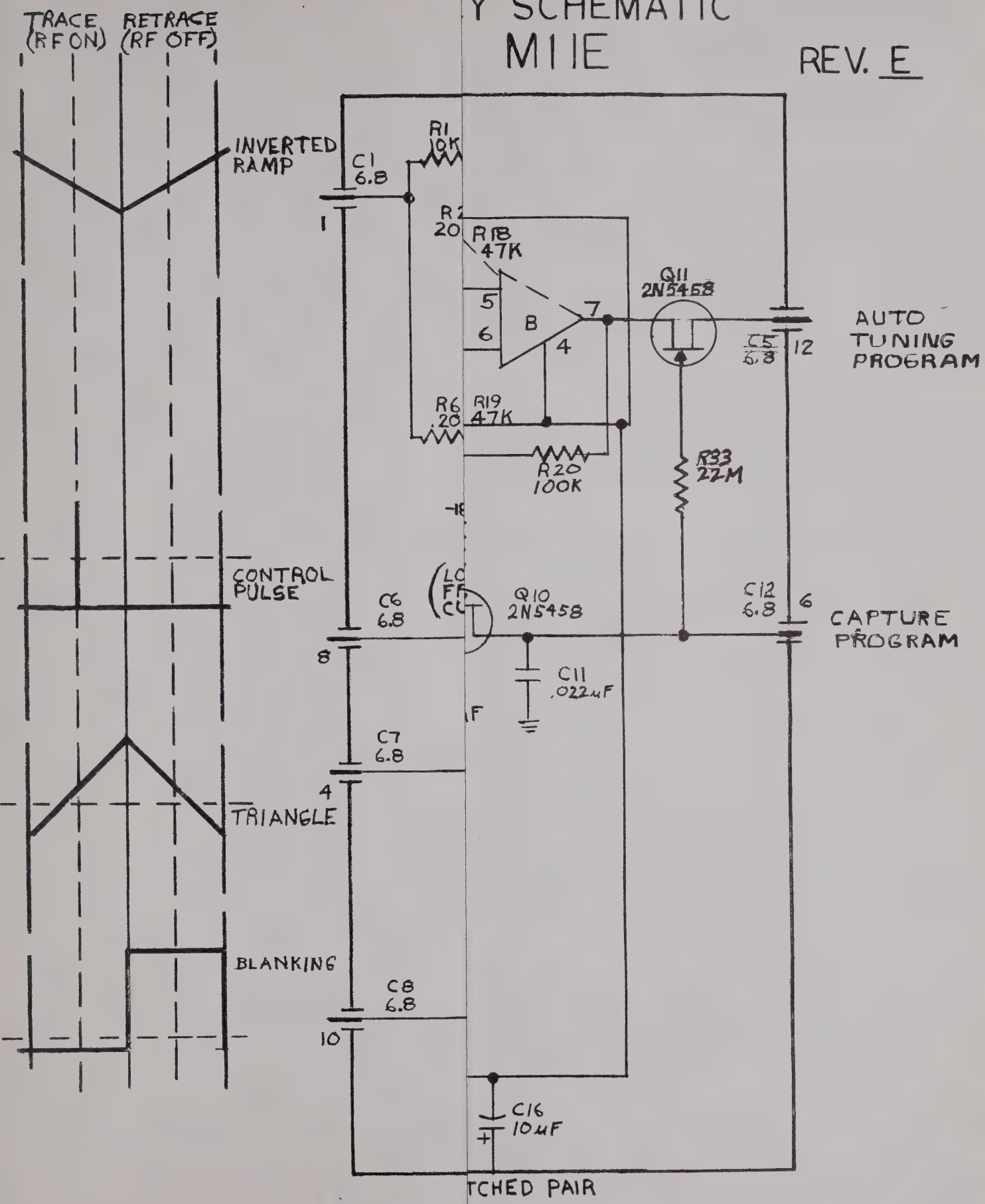


PARTS LIST

MODULE M8E REV D

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER		TQ
			CODE	NUMBER	
"R "	RESISTORS				
35	Fixed, comp., 270k ohm ±10% ¼W	RC104-427	A-B	CB2741	1
36,51	Fixed, comp., 1.8k ohm ±10% ¼W	RC104-218	A-B	CB1821	2
38,81	Fixed, comp., 10M ohm ±10% ¼W	RC104-610	A-B	CB1061	2
39	Fixed, comp., 39k ohm ±5% ¼W	RC103-339	A-B	CB3935	1
40,41,66*	Fixed, comp., 180k ohm ±10% ¼W	RC104-418	A-B	CB1841	3
48,83	Fixed, comp., 22k ohm ±10% ¼W	RC104-322	A-B	CB2231	2
49	Fixed, comp., 680k ohm ±10% ¼W	RC104-468	A-B	CB6841	1
56,82	Fixed, comp., 18k ohm ±10% ¼W	RC104-318	A-B	CB1831	2
60	Fixed, comp., 220k ohm ±10% ¼W	RC104-422	A-B	CB2241	1
62,63,86	Fixed, comp., 100M ohm ±10% ¼W	RC104-710	A-B	CB1071	3
67	Fixed, comp., 470k ohm ±5% ¼W	RC103-447	A-B	CB4745	1
68	Fixed, comp., 100k ohm ±5% ¼W	RC103-410	A-B	CB1045	1
71	Fixed, comp., 24k ohm ±5% ¼W	RC103-324	A-B	CB2435	1
72	Fixed, comp., 2.7k ohm ±10% ¼W	RC104-227	A-B	CB2721	1
"S "	SWITCHES				
1,2	SPDT Submin.	ST000-003	ALC	MST105D	2
"Q "	TRANSISTORS				
1/2,3/4 12/13,16/17	N Channel JFET Matched Pair	QB000-017	W-I	QB000-017	4
5,6	NPN Silicon	QA038-541	G-E	2N3854A	2
7,10,11,19 20	N Channel JFET	QA054-580	MOT	2N5458	5
8,9,14,15	PNP Silicon	QB000-009	MOT	MPS3702	4
18	PNP Silicon	QA036-440	FCD	2N3644	1

Y SCHEMATIC
M11E
REV. E



PARTS LIST — MODULE M8E REV D

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"C "	CAPACITORS				
1,4,6,7,13 20,21,25	Ceramic feedthru 6.8pF ±10% 500V	CF102-R68	A-B	FA5C	8
2	Mylar paper .1uF ±10% 200V	CP101-410	CDE	WMF	1
3,23	Mylar paper .047uF ±10% 100V	CP103-047	CDE	WMF	2
5	Ceramic disc 120pF ±5% 1kV	CD104-112	SPR	10TCU-T12	1
8,9,10,14,15 16,18,19,29	Ceramic disc,.001uF ±20% 1kV	CD102-210	SPR	5GA-D1	9
11	Ceramic disc. 270pF ±20% 1kV	CD102-127	SPR	5GA-T27	1
12	Ceramic disc 120pF ±20% 1kV	CD102-112	SPR	5GA-T12	1
17	Ceramic disc. 360pF ±20% 1kV	CD102-136	SPR	5GA-T36	1
22,24	Mylar paper .15uF ±10% 100V	CP103-415	CDE	WMF	2
26,27,28	Ceramic feedthru, 470pF ±20% 500V	CF101-147	A-B	FA5C	3
"CR "	DIODES				
1 to 7,9	Silicon junction, 100piV 750mA	DR000-001	ITR	1N4002	8
8	Zener, 6.8V	DB000-001	C-L	HW6-8	1
"IC "	INTEGRATED CIRCUITS				
1,2,3,4,7	Dual operational amplifier, 8 pin in line	IC000-005	T-I	72558P	5
5,6	Timer, 8 pin in line	IC000-006	SIG	NE555V	2
"R "	RESISTORS				
1	Fixed, comp., 2.2M ohm ±10% ¼W	RC104-522	A-B	CB2251	1
2,16,65,77 87	Fixed, comp., 4.7k ohm ±10% ¼W	RC104-247	A-B	CB4721	5
3,4,18,19 69,70,79.80	Fixed, comp., 47k ohm ±5% 1/8W	RC101-347	A-B	BB4735	8
5,8,9,10,11 22,23,55,57 76,85	Fixed, comp., 10k ohm ±10% ¼W	RC104-310	A-B	CB1031	11
6	Fixed, comp., 91k ohm ±5% ¼W	RC103-391	A-B	CB9135	1
7	Variable carbon 20k ohm	RP124-320	A-B	WA2G032	1
12,73,84,88	Fixed, comp., 1k ohm ±10% ¼W	RC104-210	A-B	CB1021	4
13	Fixed, comp., 9.1k ohm ±5% ¼W	RC103-291	A-B	CB9125	1
14,43,47	Variable cermet 20k ohm	RP130-320	BEK	89PR20K	3
15,54,78	Fixed, comp., 1M ohm ±10% ¼W	RC104-510	A-B	CB1051	3
17,24,32,52 58,64	Fixed, comp., 47k ohm ±10% ¼W	RC104-347	A-B	CB4731	6
20,21,42,46 53,61,74,75	Fixed, comp., 100k ohm ±10% ¼W	RC104-410	A-B	CB1041	8
25,44,45,59	Fixed, comp., 470k ohm ±10% ¼W	RC104-447	A-B	CB4741	4
26,37	Fixed, comp., 22M ohm ±10% ¼W	RC104-622	A-B	CB2261	2
27,28	Fixed, comp., 47k ohm ±5% ¼W	RC103-347	A-B	CB4735	2
29	Fixed, comp., 120k ohm ±5% ¼W	RC103-412	A-B	CB1245	1
30	Fixed, comp., 18k ohm ±5% ¼W	RC103-318	A-B	CB1835	1
31	Fixed, comp., 22k ohm ±5% ¼W	RC103-322	A-B	CB2235	1
33	Fixed, comp., 33k ohm ±10% ¼W	RC104-333	A-B	CB3331	1
34,50	Fixed, comp., 56k ohm ±10% ¼W	RC104-356	A-B	CB5631	2

PARTS LIST — MODULE M8E REV D

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"R "	RESISTORS				
35	Fixed, comp., 270k ohm ±10% ¼W	RC104-427	A-B	CB2741	1
36,51	Fixed, comp., 1.8k ohm ±10% ¼W	RC104-218	A-B	CB1821	2
38,81	Fixed, comp., 10M ohm ±10% ¼W	RC104-610	A-B	CB1061	2
39	Fixed, comp., 39k ohm ±5% ¼W	RC103-339	A-B	CB3935	1
40,41,66*	Fixed, comp., 180k ohm ±10% ¼W	RC104-418	A-B	CB1841	3
48,83	Fixed, comp., 22k ohm ±10% ¼W	RC104-322	A-B	CB2231	2
49	Fixed, comp., 680k ohm ±10% ¼W	RC104-468	A-B	CB6841	1
56,82	Fixed, comp., 18k ohm ±10% ¼W	RC104-318	A-B	CB1831	2
60	Fixed, comp., 220k ohm ±10% ¼W	RC104-422	A-B	CB2241	1
62,63,86	Fixed, comp., 100M ohm ±10% ¼W	RC104-710	A-B	CB1071	3
67	Fixed, comp., 470k ohm ±5% ¼W	RC103-447	A-B	CB4745	1
68	Fixed, comp., 100k ohm ±5% ¼W	RC103-410	A-B	CB1045	1
71	Fixed, comp., 24k ohm ±5% ¼W	RC103-324	A-B	CB2435	1
72	Fixed, comp., 2.7k ohm ±10% ¼W	RC104-227	A-B	CB2721	1
"S "	SWITCHES				
1,2	SPDT Submin.	ST000-003	ALC	MST105D	2
"Q "	TRANSISTORS				
1/2,3/4 12/13,16/17	N Channel JFET Matched Pair	QB000-017	W-I	QB000-017	4
5,6	NPN Silicon	QA038-541	G-E	2N3854A	2
7,10,11,19 20	N Channel JFET	QA054-580	MOT	2N5458	5
8,9,14,15	PNP Silicon	QB000-009	MOT	MPS3702	4
18	PNP Silicon	QA036-440	FCD	2N3644	1

AUTOMATIC FREQUENCY SCHEMATIC
OPTION E MODULE M11E

REV. E

TRACE (RF ON) RETRACE (RF OFF)

INVERTED RAMP

CONTROL PULSE

TRIANGLE

BLANKING

AUTO GAIN (END BAND ADJ.)

AUTO CENT

(MID BAND ADJ.)

(LOW FREQ CUTOUT) LOW LIMIT

IC1 72558P

IC2 72558P

AUTO TUNING PROGRAM

CAPTURE PROGRAM

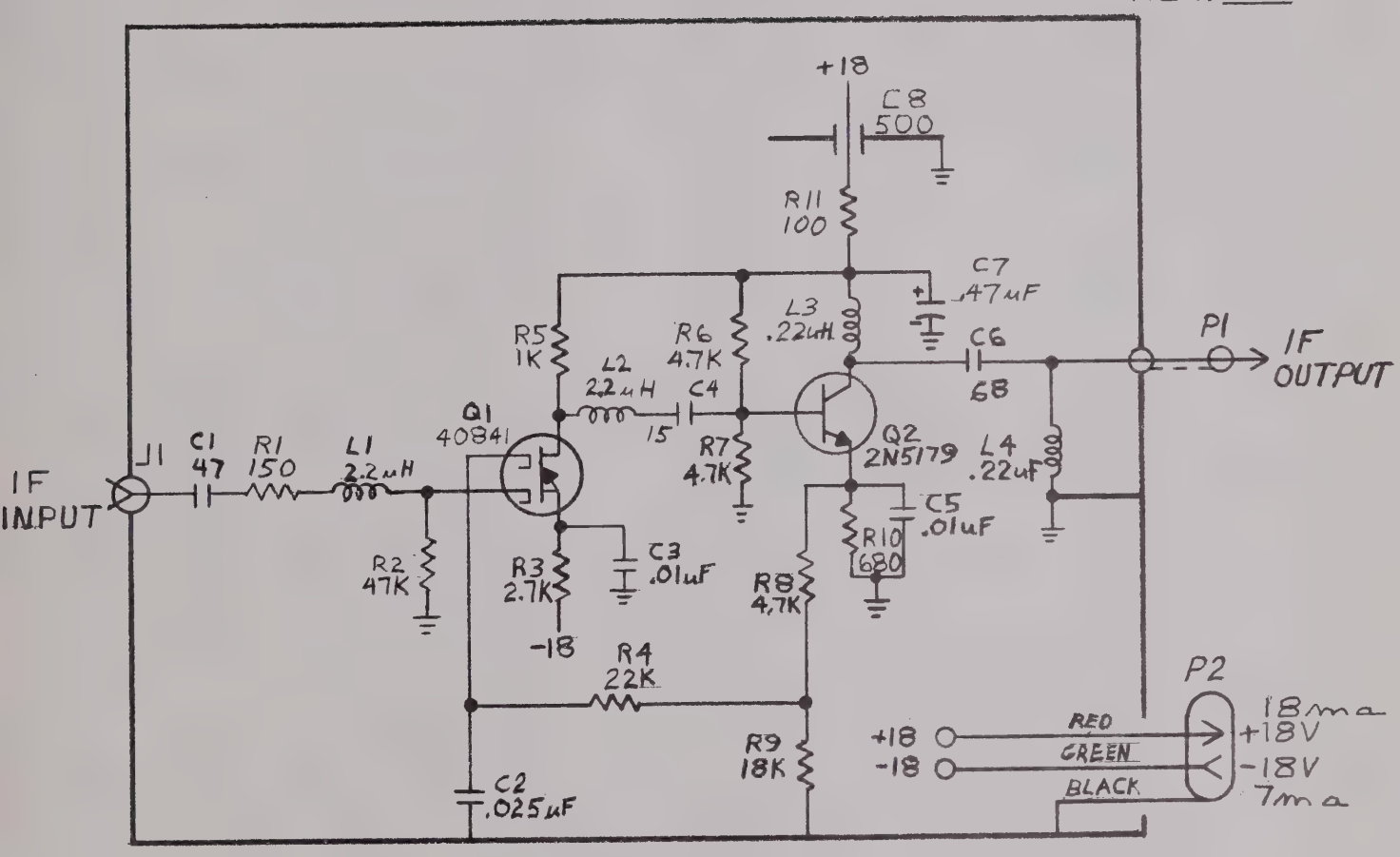
MATCHED PAIR

12 mA

12 mA

AMPLIFIER SCHEMATIC
PROBE RB

REV. A

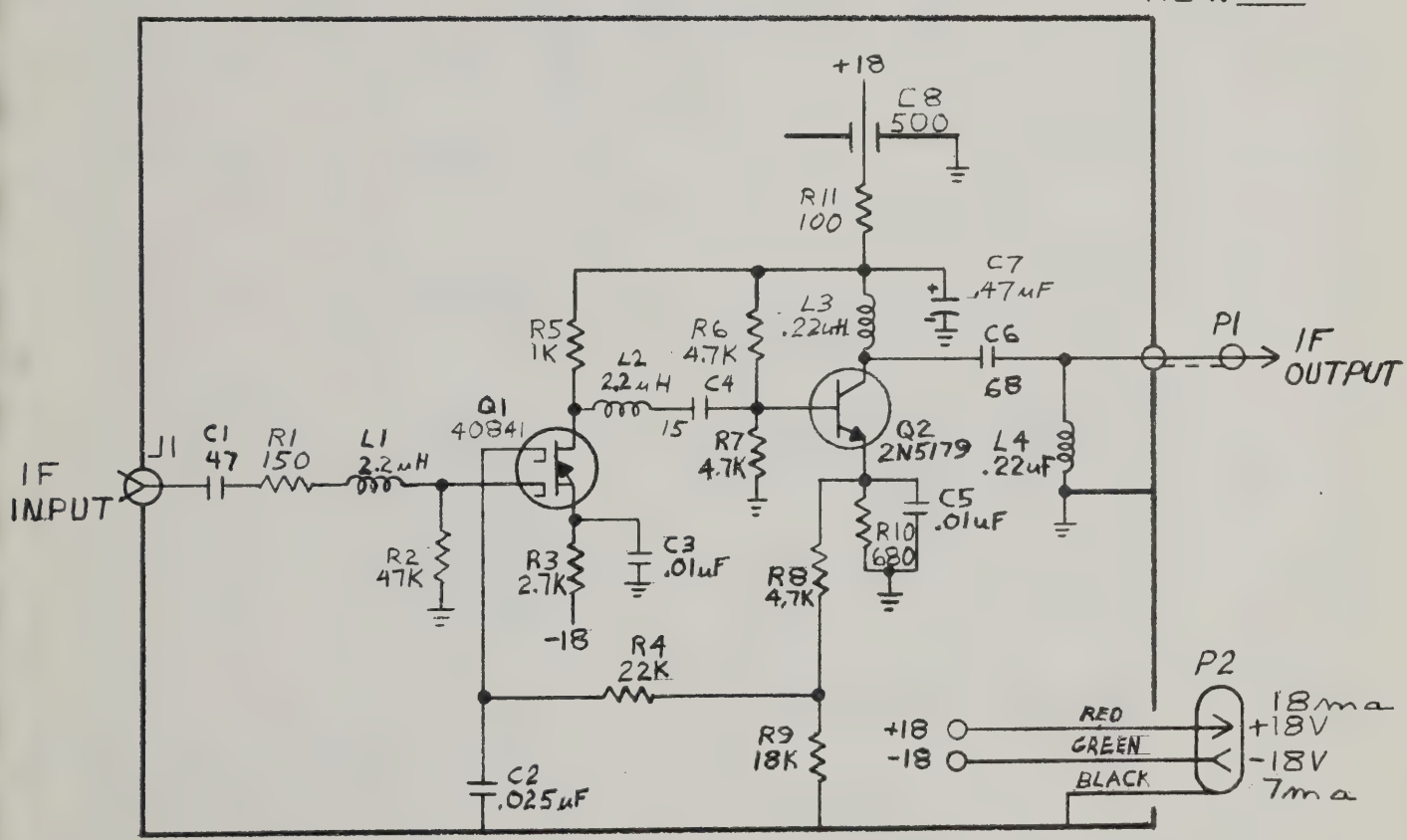


PARTS LIST — MODULE M11E REV E

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"C "	CAPACITORS				
1,5,6,7,8, 12	Ceramic feedthru, 6.8pF ±10% 500V	CF102-R68	A-B	FA5C	6
2	Ceramic disc, 200pF ±20% 1kV	CD102-120	SPR	5GA-T20	1
3,11	Mylar paper, .022uF ±10% 100V	CP103-322	CDE	WMF	2
4	Mylar paper, .0022uF ±10% 200V	CP101-222	CDE	WMF	2
9	Ceramic disc, .01uF ±20% 100V	CD103-310	SPR	TG-S10	1
10	Mylar paper, .047uF ±10% 100V	CP103-347	CDE	WMF	1
13,14	Ceramic feedthru, 470pF ±10% 500V	CF101-147	A-B	FA5C	2
15,16	Electrolytic, 10uF 25V	CE105-010	SPR	TE1204	2
"CR "	DIODES				
1 to 5	Silicon Junction, 100piV, 750mA	DR000-001	ITR	1N4002	5
"IC "	INTEGRATED CIRCUITS				
1,2	Dual operationam amplifier 8 pin	IC000-005	MOT	MC1458CP1	2
"R "	RESISTORS				
1,21,22	Fixed, comp., 10k Ω ±10% ¼W	RC104-310	A-B	CB1031	3
2,4,9	Variable, cermet, 20k Ω	RP130-320	BEK	89PR20K	3
3,25	Fixed, comp., 470k Ω ±10% ¼W	RC104-447	A-B	CB4741	2
5,17	Fixed, comp., 4.7k Ω ±10% ¼W	RC104-247	A-B	CB4721	2
6	Fixed, comp., 20k Ω ±5% ¼W	RC103-320	A-B	CB2035	1
7	Fixed, comp., 33k Ω ±10% ¼W	RC104-333	A-B	CB3331	1
8,13,14,15 16,20,27	Fixed, comp., 100k Ω ±10% ¼W	RC104-410	A-B	CB1041	7
10,28	Fixed, comp., 10M Ω ±10% ¼W	RC104-610	A-B	CB1061	2
11,12,32	Fixed, comp., 100M Ω ±10% ¼W	RC104-710	A-B	CB1071	3
18,19,24,29 30	Fixed, comp., 47k Ω ±10% ¼W	RC104-347	A-B	CB4731	5
23	Fixed, comp., 18k Ω ±10% ¼W	RC104-318	A-B	CB1831	1
26	Fixed, comp., 220k Ω ±10% ¼W	RC104-422	A-B	CB2241	1
31	Fixed, comp., 120k Ω ±10% ¼W	RC104-022	A-B	CB1241	1
33	Fixed, comp., 22M Ω ±10% ¼W	RC104-622	A-B	CB2261	1
34	Fixed, comp., 120k Ω ±10% ¼W	RC104-022	A-B	CB2201	1
35	Fixed, comp., 27 Ω ±10% ¼W	RC104-027	A-B	CB2701	1
"Q "	TRANSISTORS				
1,2,3,8,10 11	N-channel JFET, Silicon	QA054-580	MOT	2N5458	6
4/5	N-channel JFET, matched pair	QB000-017	W-I	QB000-017	1
6,7	PNP, Silicon	QB000-009	MOT	MPS3702	2
9	NPN, Silicon	QA038-541	G-E	2N3854A	1

AMPLIFIER SCHEMATIC
PROBE RB

REV. A



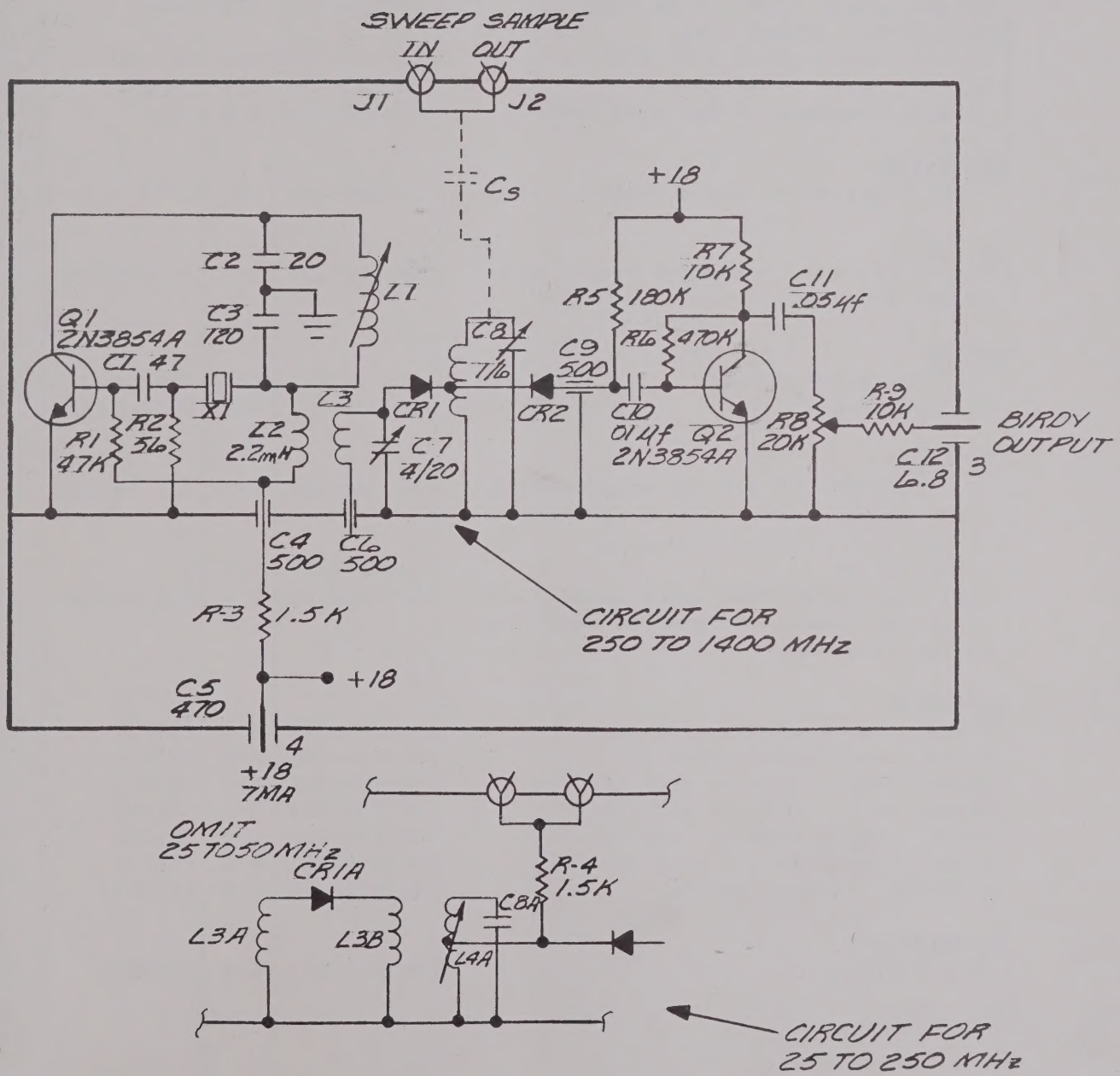
PARTS LIST

PROBE RB REV A

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"C"	CAPACITORS				
1	Ceramic disc 47pF ±5% 1kV	CD104-047	SPR	10TCU-Q47	1
2	Ceramic disc .025uF ±20% 100V	CD103-325	SPR	TG-S25	1
3,5	Ceramic disc .01uF ±20% 100V	CD103-310	SPR	TG-S10	1
4	Ceramic disc 15pF ±5% 1kV	CD101-015	SPR	10TCC-Q15	1
6	Ceramic disc 68pF ±5% 1kV	CD101-068	SPR	10TCU-Q68	1
7	Electrolytic .47uF	CE113-447	TRW	935	1
8	Ceramic feedthru 500pF ±20% 250V	CE104-150	AER	EF4	1
"J"	CONNECTORS (JACK)				
1	BNC Jack Receptacle	JB109-111	APL	UG911A/U	1
"P"	CONNECTORS (PLUG)				
1	BNC, Cable	JB100-883	APL	UG88C/U	1
1	BNC, Twinax cable	JB000-016	APL	31-224	1
"L"	INDUCTORS				
1,2	Fixed, 2.2uH	LA001-R22	JEF	15	2
3,4	Fixed, .22uH	LA001-R02	JEF	15	2
"R"	RESISTORS				
1	Fixed, comp 150 ohm ±10% ¼W	RC104-115	A-B	CB1511	1
2	Fixed, comp 47k ohm ±10% ¼W	RC104-347	A-B	CB4731	1
3	Fixed, comp 2.7k ohm ±10% ¼W	RC104-227	A-B	CB2721	1
4	Fixed, comp 22k ohm ±10% ¼W	RC104-322	A-B	CB2231	1
5	Fixed, comp 1k ohm ±10% ¼W	RC104-210	A-B	CB1021	1
6,7	Fixed, comp 4.7k ohm ±10% ¼W	RC104-247	A-B	CB4721	2
8,9	Fixed, comp 18k ohm ±10% ¼W	RC104-318	A-B	CB1831	2
10	Fixed, comp 680 ohm ±10% ¼W	RC104-168	A-B	CB6811	1
11	Fixed, comp 100 ohm ±10% ¼W	RC104-110	A-B	CB1011	1
"Q"	TRANSISTORS				
1	N channel IGFET, Silicon	QB000-020	RCA	40841	1
2	NPN, Silicon	QA051-790	RCA	2N5179	1

SINGLE FREQ MARKER SCHEMATIC
OPTION A1
FREQ RANGE 25 TO 1400 MHz
MODULE M6S-____

REV A



PARTS LIST

MODULE M6S REV A
25-1400

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
" C "	CAPACITORS				
1	Ceramic disc, 47pF ±5% 1kV	CD-104-047	SPR	10TCU-Q47	
2	Ceramic disc, 20pF ±5% 1kV	CD-101-020	SPR	10TCC-Q20	
3	Ceramic disc, 120pF ±5% 1kV	CD-104-112	SPR	10TCU-T12	
4,6,9	Ceramic feedthru, 500pF ±20% 250V	CF-104-150	AER	EF4	
5	Ceramic feedthru, 470pF ±20% 500V	CF-101-147	A-B	FA5C	
7	Variable, ceramic, 4/20pF	CV-105-020	STR	S-TRIKO	
8	Variable, ceramic, 1/6pF	CV-106-R60	APX	2222-802	
8A	Ceramic disc, from 4.7 to 20pF varies with marker freq.	CD-101 ---	SPR	10TCL	
10	Ceramic disc, .01uF ±20% 100V	CD-103-310	SPR	TG-S10	
11	Ceramic disc, .05uF ±20% 100V	CD-103-350	SPR	TG-S50	
12	Ceramic feedthru, 6.8pF ±10% 500V	CF-102-R68	A-B	FA5C	
" J "	CONNECTORS				
1,2	Jack, receptacle, 50ohm submin.	JF-000-005	APL	27-9	
" X "	CRYSTALS				
1	Quartz crystal, frequency varies with marker frequency	XX-000-331	W-I	XX-000-331	
" CR "	DIODES				
1,2	Silicon, point contact	DG-100-821	SYL	IN82AS	
1A	Silicon, Hot carrier	DG-000-007	H-P	5082-2800	
" L "	INDUCTORS				
1	Coil form No. LB-003-000 wound with 32 gauge magnet wire. Number of turns varies with crystal frequency	Not Assign.	W-I	Not Assign.	
2	Fixed, 2.2uH	LA001-R22	JEF	15	
4A	Coil Form LB-006-000, with magnet wire, gauge and number of turns to vary with marker frequency	Not Assign.	W-I	Not Assign.	
" R "	RESISTORS				
1	Fixed, comp., 47kohm ±10% ¼W	RC-104-347	A-B	CB4731	
2	Fixed, comp., 56ohm ±10% ¼W	RC-104-056	A-B	CB5601	
3,4	Fixed, comp., 1.5kohm ±10% ¼W	RC-104-215	A-B	CB1521	
5	Fixed, comp., 180kohm ±10% ¼W	RC-104-418	A-B	CB1841	
6	Fixed, comp., 470kohm ±10% ¼W	RC-104-447	A-B	CB4741	
7,9	Fixed, comp., 10kohm ±10% ¼W	RC-104-310	A-B	CB1031	
8	Variable, carbon, 20kohm	RP-124-320	A-B	WA2G032	
" Q "	TRANSISTORS				
1,2	NPN, Silicon	QA-038-541	G-E	2N3854A	